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Ocenění společnosti Huanneng Power International, Ltd. za rizika

The Huaneng Power International, Ltd. Company Valuation under Risk

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The declaration

"Herewith I declare that I elaborated the entire thesis, including all annexes, independently."

Ostrava dated 20th April 2016

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Contents

1 Introduction

Nowadays, company's valuation plays an important role in finance, and it is widely used in economic activity, for instance, financial decision marking under risk, mergers and acquisition between company, public initial offering and so on.

In this thesis, the main goal is to estimated equity value of a company which is called Huaneng company, the company belongs to power industry in China. We will collect 10 years' company's data and depending on this period data, valuation of equity for Huaneng company will made by calculation.

Overall, we divided thesis into fives chapters

In chapter 1, the main goal and structure of our thesis will be introduced.

In chapter 2, the core method (DCF method) for company's valuation will be description. then the way how make prediction for FCFE will be introduced. Moreover, some important financial models and statistics test will be explained in more detail. In summarize, all method which we will used in chapter 4 will be described in this chapter.

In chapter 3, the basic information of Huaneng company will be introduced, it including overview for Huaneng company, history description for Huaneng company, at last, power industry analysis in Chinese market will be description, which including the characteristic of power industry in China and main competitors in market for Huaneng company.

Chapter 4 is application part. which is the most important part in our thesis, in chapter, the method which we description in Chapter 2 will be used, the whole process for calculation will be showed in this part. Finally, the valuation for Huaneng company will be made.

Chapter 5, the procedures of the valuating will be made and we will make some comments for finally valuation result.

2 Description of the Company Valuation Methods

In this part we will introduce company valuation method which we will use or may be used in chapter 4, it is including financial ratio analysis, pyramidal decomposition, Vasicek model, regression method and weight moving average method, free cash flow to equity of company. DCF method, two-stage method, sensitivity analysis. The theoretical background relief on the following resources: *Brigham (2014), pages (89-109) and pages (336-360). Dluhosova(2014), page (22-30) and pages (110-119). Koller, Goedhart and Wessels (2010), pages (214-270).* Zmeškal (*2004), pages (172-186).*

2.1 General description of company valuation

Company valuation is a process to determination company's value, it can be value of whole company or value of equity for company. It is widely used in financial market, especially for investor who want do long-term investment for stock and acquisition who want acquisition the other company, it is important to know intrinsic value of company. It also can be used in estate, gift taxation, divorce litigation and so on.

There are three standard value which must be introduce:

A) Fair market value

Fair market value defines as the price at which the property would change hands between a willing buyer and a willing seller, neither being under and compulsion to buy or sell and both having reasonable knowledge of relevant facts. Fair market value for tax purpose also assumes a hypothetical willing buyer and a hypothetical willing seller. Fair market value is used most often in tax situation, it is also used in many buy or sell agreements and marital dissolution situation.

B) Investment value

The investment value defines as the value to a particular investor based on individual investment requirements and expectation. Investment value is the value to a particular investor which reflects the particular and specific attributes of that investors.

C) Intrinsic value

Intrinsic value is based on the fundamental analyses of companies, particularly publicly traded companies.it is often defined as following: a comprehensive guide to today's valuation methods, future dividends are derived from earning forecasts and the discounted to present, thereby establishing a present value for the stock. If the stock is trading at a price lower than this calculation, it is a 'buy"; if the market price is higher than the intrinsic value, the stock is a 'sell".

Generally, we can use three different methods to estimate value of company. they are Income approach, market approach and asset approach。

The **Income Approach** is used to estimate enterprise and equity value. The income approach seeks to identify the future economic benefits to be generated by an entity and to compare them with a required rate of return. It is calculating the value by future cash flow divided by the internal require rate of return. There are three methods in the income approach: they are the DCF methods, EVA methods (economic value added methods), and the capitalized income methods. In this thesis, we will describe the DCF methods which we will use in the practical part.

The **assets approach** uses the books of the company to identify the fair value of the assets, both tangible and intangible, and the liabilities to determine a net value for the company. Whereas the market and income approaches both focus on income statement activity, the asset approach primarily focus on the company's balance sheet. here are several to estimate the value of the company by assets approach, they are Book value, Adjusted book value, Substantial value Liquidation value.

The **market approach** can determine the value of company or business by reference to reasonably comparable company (very similar company, for example, same scale, same industry, similar products) for which values can be known. Sometimes, we can get known the value of a comparable company because the company is IPO or it was recently sold.

2.2 Financial ratio analysis

In this thesis ,we will focus on ROE, so component ratio of ROE will be describe, they are net profit margin, assets turnover and financial leverage.

Return on equity (ROE) measure company's profitibability how much profit a company generates with the money shareholders have invested, it can express as following:

$$Return\ on\ equity\ (ROE) = \frac{net\ income}{Total\ equity}\ , \qquad (2.1)$$

the higher ROE, the more benefit shareholders could get from company, the better reputation company could get from stock exchange market.

Net profit margin measures how much out of every dollar of sales a company actually keeps in earnings. Profit margin is very useful when comparing companies in similar industries. It can calculate as following:

$$Net\ profit\ margin = \frac{Net\ profit}{revenue}, \qquad (2.2)$$

a higher profit margin indicates a more profitable company that compared to its competitors.

Assets Turnover is an efficiency ratio which tells how successfully the company is using its assets to generate revenue, it can express as following:

$$Assets\ turnover = \frac{Revenue}{Total\ assets}\ , \qquad (2.3)$$

if amount of total assets doesn't change, more revenue the company, more efficiency the company using its assets.

Financial leverage be defined as the degree to which a company uses fixed-income securities, it can be express as following:

$$\text{Financial leverage} = \frac{Total\ assets}{equity}\ , \qquad (2.4)$$

with a high degree of financial leverage come high interest payments.

2.3 Pyramidal decomposition

Pyramidal decomposition use to analysis what drives value of financial ratios, which component ratio has biggest influence on basic ratio. The principle of pyramidal decomposition is to express selected (basic) ratio as a product of component ratios. The fundamental example of the pyramidal decomposition is the DuPont analysis. The decompose ROE ratio by three component ratios, the net profit margin, the assets turnover and the leverage, following it is:

$$ROE = \frac{net\ income}{revenue} * \frac{revenue}{total\ assets} * \frac{total\ assets}{equity} \quad . \tag{2.5}$$

In order to find out which component ratio has biggest influence on ROE, we will use one method which is called method of gradual changes, method of gradual changes is enabling to quantify the change in the basic ratio caused by change in the component ratio. Following it is formula:

$$\begin{aligned} \Delta x_{ai} &= \Delta a_1 \cdot a_{2,0} \cdot a_{3,0} \ldots\ldots a_{n,0} \cdot \frac{\Delta y_x}{\Delta x} \\ \Delta x_{a2} &= a_{1,1} \cdot \Delta a_2 \cdot a_{3,0} \ldots\ldots a_{n,0} \cdot \frac{\Delta y_x}{\Delta x}, \\ &\ldots\ldots\ldots\ldots \\ \Delta x_{a,n} &= a_{1,1} \cdot a_{2,1} \cdot a_{3,1} \ldots\ldots \Delta a_n \cdot \frac{\Delta y_x}{\Delta x} \quad . \end{aligned} \tag{2.6}$$

Generally, the decomposition by means of this method can be written as:

$$\Delta a_{xi} = \prod_{j<i} a_{j,0} * \prod_{j>i} a_{j,1} * \frac{\Delta y_x}{\Delta x} \quad , \tag{2.7}$$

the x is the basic ratio, Δx is the absolute change of the basic ratio, the a is the component ratio, and the Δa is the absolute change in the component ratio, after we get all Δx_{ai}, we can make order to find out the which components has biggest influence on basic ratio.

2.4 Parameter estimate

In application, we need know some parameters to express our prediction result, for instance, mean(expected) return, sample variance, sample standard derivation of returns and percentile:

In probability and statistics, mean and expected value are used synonymously to refer to one measure of the central tendency either of a probability distribution or of the random variable characterized by that distribution, it can be express as sum of values divided by number of values, following is formula:

$$\mathrm{E}(R_i) = \frac{1}{N} * \sum_{t=1}^{N} R_{i,t} \ , \tag{2.8}$$

We can easy calculate mean by excel function AVERAGE(R).

Variance and standard derivation measures of variability (also called measures of dispersion or spread), all number of variance and standard derivation is positive. The standard derivation is squared of variance, so it is same direction, with variance increase, the standard derivation increase as well. a small variance indicated that data point trend is very closed to mean, a large number variance indicated data points are spared to mean. Following are formula for variance (sample and population) and standard derivation (sample and population):

Sample variance of returns

$$\sigma_i^2 = \frac{1}{N-1} * \sum_{t=1}^{N} [R_{i,t} - E(R_i)]\text{^}2 \ . \tag{2.9}$$

Population variance of returns

$$\sigma_i^2 = \frac{1}{N} * \sum_{t=1}^{N} [R_{i,t} - E(R_i)]\text{^}2 \ . \tag{2.10}$$

Sample standard deviation of returns

$$\sigma_i = \sqrt{\frac{I}{N-1} * \sum_{t=1}^{N} [R_{i,t}} - E(R_i)\text{^}2 \ . \tag{2.11}$$

Population standard deviation of returns

$$\sigma_i = \sqrt{\frac{I}{N} * \sum_{t=1}^{N} [R_{i,t}} - E(R_i)\text{^}2 \ , \tag{2.12}$$

N represent number of sample or population, $R_{i,t}$ are data points, $E(R)_i$ is mean of population or sample. All of these formula we can easy calculate by excel, sample

variance can be calculated by VAR(R), Population variance can be calculated by VARP(R), sample standard derivation can be calculation by function STDEV(R), Population standard derivation can be calculated by STDEVP(R).

A percentile provide information about how the data are spread over the interval from the smallest value to the largest value. The pth-percentile divides the data into two parts. Approximately p percent of the observations have values less than the pth-percentile and approximately (100-p) percent of the observations have values greater than the pth-percentile. Percentile also can be calculated by excel Percentile (R: P)

2.5 Single-index model and statistical test

In financial modeling the most applied models are one factor model or mutil-factor model, we will use single-index model for prediction in character 4, usually single-index model can be get by basic approach LSM, LSM is called the least square method due to is based on minimizing the sum of square derivations. The stochastic characteristic equation of single -index model can be defined by following:

$$R_{i,t} = \beta_0 + \beta_1 * R_{m,t} + \mu_t \ , \qquad (2.13)$$

where $R_{i,t}$ is dependent variable, $R_{m,t}$ is independent variable, β_0 is an estimate of the intercept constant, β_1 is slope (regression coefficient), μ_t is the residual deviation.

After we get the single-index model, we need know our estimate is significance or not, both for our model and parameters.

In statistic we use t-test for testing the statistical significance of parameters. Firstly, we need do hypothesis, following it is:

Null hypothesis, H_0: β_i=0

Alternate hypothesis $H_1: \beta_1 \neq 0$

Under this t-statistic, it is assumed that this statistic has Student's distribution with df-degrees of freedom. How to make a decision if we reject null hypothesis or accepts null hypothesis? The decision rule is based on two parameters, t^{calc} (the calculated t-statistic, which corresponds to given estimated value β_i) and t^{crit} (which determines

the percentile of the t-statistic on given level of significance α. Following it is how to get these two parameters:

$$t_{df}^{calc} = \frac{\beta_i}{SE_{\beta i}} \ , \tag{2.14}$$

$$t_{\frac{\alpha}{2};df}^{crit} = ST_{df}^{-1}\ (\frac{\alpha}{2}, \tag{2.15}$$

in the formula $SE_{\beta i}$ is standard error of β_i coefficient, ST is the Student's distribution function, ST_{df}^{-1} （$\frac{\alpha}{2}$） is its inverse function on significance level $\frac{\alpha}{2}$ with df degrees of freedom, it can be calculated as following:

$$\text{Value } P_{df}=\alpha^{calc} = ST_{df}\left(t_{df}^{calc}\right) * 2 \ . \tag{2.16}$$

After we get these two parameters, we can make compared, following it is rule:

$$\begin{aligned} &\text{If } \left|t_{df}^{calc}\right| > t_{\frac{\alpha}{2};df}^{crit}, \text{ then we reject } H_0 \\ &\text{If Value } P_{df}<\alpha, \text{ then we reject } H_0 \quad , \\ &\text{If } \left|t_{df}^{calc}\right| \leq t_{\frac{\alpha}{2};df}^{crit}, \text{ then we reject } H_0 \\ &\text{If Value } P_{df} \geq \alpha, \text{ then we reject } H_0 \end{aligned} \tag{2.17}$$

the rejection of null hypothesis means that the calculated t-statistics coefficient falls into the critical area, so it is statistically significant that this parameter should including in this model, if we accepted null hypothesis, this parameter should remove from this model.

In statics we use F-test for testing the significance for whole model, Firstly, we need to do hypothesis:

Null hypothesis, $H_0: \beta_0 = \beta_1 = 0$

Alternate hypothesis: $H_1: \beta_0 \neq 0 \ or \ \beta_1 \neq 0$

Under F test, the test is on the basic of the F-statistic providing that the statistic is of the Fisher distribution. The evaluation is based on compare value of statistic,F^{cal}, and the critical value of the statistic, F^{crit}, following it is:

$$F_{dfESS;dfRSS}^{calc} = \frac{MS_{ESS}}{MS_{RSS}} = \frac{ESS/df_{ESS}}{RSS/MS_{RSS}} \ , \tag{2.18}$$

$$F_{df_{ESS;df_{RSS}}}^{crit} = FISH_{df_{ESS:df_{RSS}}}^{-1}(\alpha) \ , \tag{2.19}$$

where ESS is the Explained Sum of Squares, RSS is the Residual Sum of Square,MS_{ESS} is the Mean Square Explain and MS_{RSS} is the Mean Square Residual, df_{ESS} and df_{RSS} are degree of freedom assigned to variance, df_{ESS}=K+1, df_{RSS}=T-(K+1), where K is number of independent variables, add 1 which means the degree of freedom is influenced by intercept constant. Here FISH means distribution function of Fisher's distribution and $FISH^{-1}_{df_{ESS:df_{RSS}}}$ it its inverse function on probability level α, we can get α as following:

$$\text{Value } P_{df_{ESS:df_{RSS}}} = \alpha^{calc} = FISH_{df_{ESS;df_{RSS}}}(F^{calc}) \ . \qquad (2.20)$$

After we get these two parameters, we can make compared, following it is rule:

$$\begin{aligned} &\text{If } F^{calc}_{df_{ESS;df_{RSS}}} > F^{crit}_{a;df_{ESS;df_{RSS}}}\text{,then we reject } H_0 \\ &\text{If Value } P_{df_{ESS;df_{RSS}}} < \alpha\text{, then we reject } H_0 \ , \qquad (2.21) \\ &\text{If } F^{calc}_{df_{ESS;df_{RSS}}} \leq F^{crit}_{a;df_{ESS;df_{RSS}}}\text{,then we reject } H_0 \\ &\text{If Value } P_{df_{ESS;df_{RSS}}} \geq \alpha\text{, then we reject } H_0 \ . \end{aligned}$$

The rejection of the null hypothesis means that estimated model is statistically significant and acceptance null hypothesis means that estimated is not statistically significant, which represent we cannot use this model.

2.6 Vasicek Model

Vasicek model belongs to mean-reverting model, it is one model that allow estimate could be negative, as we will prediction net profit margin, it could be negative as well, so Vasicek Model maybe can be used in our prediction (after pass statistic test). The basic idea of how to use Vasicek model is by using LMS transform the original mean-reversion model into linear model, estimate its parameters and then recalculated parameters of original model, following it is:

Estimated discrete mean-reversion Vasicek model

$$\Delta \mathrm{r} = \Delta r' + \varepsilon = a * (b - r_{t-1}) * \Delta \mathrm{t} + \sigma * \sqrt{\Delta t} * z \ , \qquad (2.22)$$

in the Vasicek model, Δr is the random increment of returns, $\Delta r'$ is the estimated trend of the statistical model, ε is a residual deviation. Where a.b is estimated parameters, Δt is time interval,σ is the standard deviation p.a., z is random variable with normal probability distribution.

Transformation the Vasicek model into liner model

$$\Delta r = \alpha + \beta * r_{t-1} + \varepsilon \ . \tag{2.23}$$

And from original model, we can get following:

$$\alpha = a * b * \Delta t \ , \tag{2.24}$$

$$\beta = -a * \Delta t \ , \tag{2.25}$$

by using Least Square Method we can get following:

$$\varepsilon_t = \Delta r - \Delta r' = \Delta r - (\alpha + \beta * r_{t-1}) \ , \tag{2.26}$$

where α and β are independent parameters

Calculation of the initial parameters of the Vasicek model

The parameters can be calculated on the basic of parameters which were estimated for the liner model, following it is:

$$a = -\frac{\beta}{\Delta t} \ , \tag{2.27}$$

$$b = \frac{\alpha'/a\prime}{\Delta t} \ , \tag{2.28}$$

$$\sigma = \frac{\sigma'}{\sqrt{\Delta t}} = \frac{\sqrt{(\frac{1}{N})\sum_t {\varepsilon_t}^2}}{\sqrt{\Delta t}} \ . \tag{2.29}$$

This model can be in return estimated, interest estimated and so on.

If it turns out that variables are not statistically significant, then by rearrangement of formula (2.20), we get the formula for expected value, which is known as the naïve prediction theory, following it is:

$$E(x_t) = x_{t-1} \ . \tag{2.30}$$

For calculation of predicted value, specific Wierer process is used, following it is:

$$x_t = x_{t-1} + x_{t-1} * \sigma * d_z * \Delta t \ , \tag{2.31}$$

where x_t is prediction value at time t, x_{t-1} is value from history at time $t-1$, σ is the standard deviation p.a., z is random variable with normal probability distribution. Δt is time interval.

2.7 Weighted moving average

Weight moving average is one of method for prediction future basic on history moving, Weighted Moving Averages involves selecting a deterrent weight for each data value and then computing a weighted average of the most recent n values as the forecast. The difference between Weight moving average and moving average is that moving averages method uses the average of the most recent n data values in the time series as the forecast for the next period, weight moving average has a weight for every number. Following we provided an example:

$$\text{WMA}=\frac{n*P_m+(\text{n}-1)*P_{m-1}+\cdots 2P_{m-n+2}+P_{m-n+1}}{n+n-1\cdots+2+1} \quad . \tag{2.32}$$

Usually the weight moving average method using in are appropriate for a stable time series (one that exhibits no significant trend, cyclical or seasonal effects, and the weight will be higher with time close to now, for example: the computation of a weighted three-week moving average, with the most recent observation receiving a weight three times as great as that given the oldest observation, and the next oldest observation receiving a weight twice as great as the oldest.

2.8 Free cash flow estimation

In this part, we will introduce free cash flow, the types of free cash free including free cash flow to company and free cash flow to equity. After that we make methodology introduction for financial plan which describe how to prediction free cash flow for future.

2.81 Definition of free cash flow

In economic activity, cash flow is important indicator, one of most important category is free cash flow(FCF), the FCF application can be found in financial management, such as investment decision under risk, financial planning for company or company's valuation under risk. The category of free cash flow could be understood

as difference between revenues and expenditures that are generated by the assets of the company and are subject to a specified type of capital. We can divide it into free cash flow to both owners and creditors (free cash flow to firm), free cash flow for owners (free cash flow to equity), free cash flow to creditors (free cash flow to debt).

The free cash flow to firm represents all of cash flows that business generates from its assets, it does not distinguish where these assets belongs (to owners or to creditors), if we distinguish free flow from owners and creditors, we can get that FCFF is calculated as sum of these two components, it can express as following formula:

$$FCFF_t = FCFE_t + FCFD_t \quad . \tag{2.33}$$

The free cash flow to equity characterizes the flows from the perspective of owners, for instance shareholders, it consists by cash flow from operating activity, financing activity and investing activity, flowing it is formula:

$$FCFE_t = EAT_t + DEP_t - INV_t - \Delta NWC_t + \Delta S_t \quad , \tag{2.34}$$

where EAT is earning after tax, it is come from operating activity of company, DEP is depreciation, INV is investment outlays, which come from investment activity of company, ΔS stands for net payments connected to the debt.

The free cash flow to debt(FCFD) indicates the flow from the perspective lenders (such as borrowing from commercial banks), it can express as following formula:

$$FCFD=I*(1-t)-\Delta S \quad , \tag{2.35}$$

where t is income tax rate,$-\Delta S$ express the net debt repayments from the creditors' points of view, the value of collected debt repayments minus the value of newly provided debt.

By combination these two formula, we can get formula for FCFF, which represent free cash flow both for owners and creditors, following it is:

$$FCFF=EAT+DEP-INV-\Delta NWC+I*(1-t) \quad . \tag{2.36}$$

As our chapters 4 will focus on prediction future FCFE, get equity value of company, so following we will describe more detail about component part for formula (2.32), and describe methodology prediction process for these component part and get future cash flow to equity, these also can be called financial plan.

2.82 Financial planning

As we describe formula (2.32) for FCFE, we need to plan future EAT, DEP, INV,ΔS and ΔNWC, firstly, we will describe these component, after that, the main idea of how to prediction these component will be describing (practice will be performance in Chapter 4). Financial planning is process to determine the future development for some items in financial statement which contribute to DCF method. following it is:

Plan of EAT

EAT means earning after tax, it is very important part for FCFE, we can get history data for EAT from income statement, EAT represent the profit which company earning, which can be calculated by total revenue minus total cost, minus interest and tax. We can see that EAT is company's income and has a lot relationship with total revenue, so we can get EAT by following formula:

$$EAT_t = REVENUE_t * Net\ profit\ margin_t \ , \qquad (2.37)$$

where net profit margin as we describe in formula (2.2), the main idea of how to prediction EAT is that, we will prediction Net profit margin depend on history data which we can collect from annual report. After that, by using regression between Revenue and GDP, we can make a prediction for revenue, finally, by using formula we can get EAT for future years, depend on different scenarios of net profit margin, we will get different scenarios for EAT as well.

Plan of Depreciation and Investment outlays

Every company has its own DEP, because company need fixed assets such as manufacture products, providing service and so on, but with using these fixed assets, the value of these assets will decreasing year by year, until it cannot by use anymore, so in company's annual report will including DEP. As describe DEP is come from fixed assets, so we can prediction DEP depend on fixed assets. So we make a regression between to get relationship between DEP and fixed assets. After we get future fixed

assets we can get future DEP. As we know that this year's fixed assets equal to previous year's fixed assets plus Investment outlays, following it is:

$$Fixed\ assets_t = Fixed_{t-1} + INV_t \ , \qquad (2.38)$$

where t represents time period, INV means investment outlays, as we describe every year company has DEP, so it also has INV, if the company only with DEP, but do not investment to fixed assets, after long period, fixed assets will run out. Here are two ways we can make prediction for INV, one way is weight moving average, the other one is we can make some assumption, which way will use depend on history data from annual report, if company's history INV with obvious trend increasing or decreasing, we can use weight moving average, or history INV with big fluctuate but it is fluctuating with mean, we can make some assumption depend on volatility and trend. After we get future INV, by using formula (2.36), we can prediction fixed assets and DEP as well.

Plan change of net working capital

Net working capital measure company's operating liquidity, with higher working capital, which represent high ability for the company to measure its operating liquidity, lower or negative working capital, which means company may lack the funds necessary for growth. Net working capital can be calculated as following:

$$Net\ working\ capital = Current\ assets - Current\ liabilities \ . \qquad (2.39)$$

Change of Net working capital can be calculated as following:

$$\Delta\text{Net working capital} = Net\ working\ capital_t - Net\ working\ capital_{t-1} \ . \qquad (2.40)$$

Net working capital can both be posivite and negative, we can not say it is more higher or more lower is benefit for company, althougth with higher working capital the company has high ability to measure its operating liquidity, with high net working capital means company hold too much idle fund. It can't produce more to get economic benefit. It also reflects the company has less opportunity to invest. It's not good for potential development.

Working capital calculted by formula (2.37), so firstly we need to predition current assets and current liabilities, current assets and current liabilities are in operating process of company, so it must be relationship with revenue, by using regression , we

can get two regression model of current assets and currents liabilities, before we has been prediction revenue, so we can get future current assets and current liabilities , after that ,we will know change of net working capital.

Plan of Net Payments (ΔS)

Net payment stand for difference between debt drawing SC, and repayment of debt SS , fllowing it is formula:

$$\Delta S = SC - SS \ , \tag{2.41}$$

where drawing SC which means in that year , company's new borrowing from bank, in order to expand scale of business, or buliding new factory, or buy fixed assets, usually , copamy will make a loan from bank, that's SC. While the company get new borrowing, it also has to pay back the money borrowed last period, it could all of that borrwing , but usualy, it is a part of borrowing plus interest. New borrowing receined could be calculated as following:

$$New\ borrowing\ received_t = Total\ loans_t - Total\ loans_{t-1} + repayment\ of\ borrowing_t \ , \tag{2.42}$$

where t means time period. Repayment of borrowing could be one part of totals, so we can use regression to get relationship between total loans and repayment of borrowing. We can prediction future total loans buy using weight moving avgeage under clearly increaing trend, with time closely to now, we will give more weight. After we get future total loans, depending on regression we can get future repayment of loans , by using formula(2.40), we can get new borrowing received, finanlly we can get future net payment as well.

2.9 Discounted cash flow method description

Discount cash flow method is under assumpation that value of assets determined by the expected utility for holder of the assets, for a company, we consider these utility as economic benefits, for example economic profit, earning, dividend ,cash flows, as one main method from income approach , DCF method based on the future cash flow

generated by businesss activity, and discount it to now. The future cash flow are one of key parameters used within business valuation, usually, company's value will change by chaning future cash flow . following it is formula for DCF method:

$$\mathrm{V} = \sum_1^T FCF_t \, (1+R)^{-t} \quad , \tag{2.43}$$

where t is particular years , R is cost of capital(cost of equity)，FCF are free cash flow(FCFF or FCFE).

In modeling ,we can consider that business activity will contiunue to infinite, but the projection of the particular free cash flow to infinite time horizon is different, in relastictis, company's business will through different satges of develpoment , for instance, company's has different rate for growth, or company with zero growth rate, following we will introduce one stage method and two stage method:

The simplest case is the situation that the company with constant behaviour during whole period ,and we assumption that company's business will continute to infitine with constant cash flow as perpetuity. The company's value can be calculated by following formula:

$$\mathrm{V} = \frac{FCF}{R} \quad . \tag{2.44}$$

Or with a constant rate of increase or decrease g in cash flows:

$$\mathrm{V} = \frac{FCF}{R-g} \quad , \tag{2.45}$$

where FCF is cash flow for company(to equity), R represent cost of capital (cost of equity), g represent growth rate of company's cash flow , if g more than 0, which represent company with growth, if g equal to 0, means company does not growth, if g is smaller than 0, the company's cash flow falls.

One stage method is simplication for DCF method, in order to more relastic , due to the possibility of free cash flow estimation, we can divided the whole comapany's businese life into two part, in our practice part ,we assume first five years as a period, it is first stage of our company's business life, the second stage will last to infinite. In the first stage we get value V1, in the second stage , we only need to estimated the trend of cash flow or assumption cash flow will be constant. The

company's value for two-stage method is equal to sum value of both stage, following it is:

$$\mathrm{V} = V_1 + V_2 \ , \tag{2.46}$$

where V1 and V2 are value for both stage. For first stage company's cash flow can be estimated more precise, thus , the value of first can be calculated by formula (2.41). In the second stage we worked with so-called terminal value, TV, it represent company's value at the begin of second stage,it can be calculated as following:

Under the assumpation constant cash flow for second stage:

$$\mathrm{TV} = \frac{FCF_{T+1}}{R_2} \ . \tag{2.47}$$

Under the assumpation free cash flow increase annlual with g:

$$\mathrm{TV} = \frac{FCF_{T+1}}{R_2 - g} \ . \tag{2.48}$$

After we get TV, we can also get company's value at second stage , following it is:

$$V_2 = TV * (1 + R_1)^{-T} \ . \tag{2.49}$$

Finally, we can make summarize for formula to calcultion value of company, following it is:

$$\mathrm{V} = \sum_{t=1}^{T} FCF_t * (1 + R_1)^{-1} + TV * (1 + R_1)^{-T} \ , \tag{2.50}$$

where all the factors is same as we describe before. The most important is that we need to distinguish value for company and value to equity. If we want to get value of company, FCF will be free cash flow to comapny, R would be cost of capital , for value of equity, FCF would be free cash flow to equity, R would be cost of equity. We have introduced how to prediction FCF, following we will introduce cost of capital (cost of equity).

2.10 Cost of capital and cost of equity

Cost of capital also called weight average cost of capital (WACC), it can be understand as minimal requared rate of return(IRR). We can understand cost of capital from two side, from firm's point view and from investor's point view. For the firm's point of view, cost of capital could be understand as the price of capital acquired for subsequent development of activities. For the investor point of view, it could be understand as the requirement for the rate of return that a frim has to accompilsh in order to preserve a value for investors. Following it is formula for cost of capital:

$$\text{WACC} = R_E * \frac{E}{A} + (1-t) * R_D * \frac{D}{A} \ , \tag{2.51}$$

where, E represet equity, D means debt and A means assets, all of we can find in balance sheet, R_E represent cost of equity, R_D represent cost of debt, t means income tax rate. In our chapther 4 , we will focus on equity value to company, so we need know how to get cost of equity deeply.

Cost of equity is mainly based on three parts: the risk-free rate, the risk premium as well as the systematic risk of the specific company in comparison to the whole market.

We can get cost of equity by using different method, it can be depend on market or depend on accounting data. Aribitage pricing model (APM), Divided growth model, build -up model Capital assets prcining model are all method can get cost of equity, in our charpeter 4, we will focus on one of market-based approach to estimeted cost of equity, it is capital asset pricing model(CAPM), following it is formula :

$$E(R)_E = R_F + \beta_E * (E(R)_M - R_F) \ , \tag{2.52}$$

where $\mathrm{E}(R)_E$ means the expected return of the equity, it from the investor side. For the company side, it is the cost of equity. R_f is the risk free rate, we usually take the internal rate of return of the government bond as the risk free rate. In our charcapter 4, we will use two stage DCF method , so we has two risk free rate as well , the first rsik free rate we can choose internal rate of return of 10 to 20 years government bond, for the second risk free rate we can choose internal rate of return of 30 to 50 years

government . $E(R_M)$ is expected return of market portfolio. $E(R_M)$-R_f is called risk premiun, it can easliy get from website. β_E is the coefficient expressing sensitivity of equity's additional return to market risk(additional return of the portfolio), Because the company can divided into leverage and unleveraged company, so the beta for the unleveraged is the same for the company which in the same sector, but the beta for the leverage company is different, so we need find the unleveraged beta from the market and calculate the leverage beta for the specific company, following are the relationship between unleveraged beta and leverage beta.

$$\beta^L = \beta^U * [1 + (1 + t) * \frac{D}{E}] \ , \tag{2.53}$$

where β^L is a beta of a leverd firm which deoending on unleverage firm β^U, D/E is debt ratio, t is tax rate. we can find β coefficient for specific company on Damodaran Online.

2.11 Sensivity analysis

Sentivistiy analysis is that find uncertainly factors in project, while this facotrs change and keep the other factor stable, what influence to this project . In our practice, we need analysis one factor change , how NPV will change . In our thesis, sensitive analysis is designed to provide answers to such question. Each variable is increased or decreased by a specified percentage from its expected value, holding other variables constant at their base-case levels. Then the NPV is calculated using the changed input. Finally, the resulting set of NPV is plotted to show how sensitive NPV is to changes in the different variables. It is calculated by the following formula:

$$\Delta V_\alpha^F = V_{1+\alpha}^F - V \ , \tag{2.54}$$

where F means the factor, such as the revenues, the FCFF, the deprecation, the g and so on, α means the growth of that factor. Sensitivity analysis also called what if analysis, one factor change, what happened with the value . V represent the value to of company (to equity).

3 Characterization of the Huaneng Power International Company

In this part, we will describe basic characteristic of Huaneng international company, first of all, we will make a berifly introduction of Huaneng company as well as shortly history review, after that, we will analysis situation of Chinese power industry and main competitors for Huaneng company in Chinese market.

3.1 Overview of Huaneng international company

Huaneng Power company is called Huaneng Power international.Inc. Huaneng company is one of biggest power generation company in China. The primary service of Huaneng company is development construction and management large-scale power plant in China.

The company’s domestic power plant is widely distributed in 21 provinces municipalities and autonomous regions in China. As one of biggest power company in China, since its establishment, Huaneng company focus on technological advances in electricity, power plant construction and management methods to create a number of domestic industry. Companies in China for the first time introduced a 600,000 kilowatts "supercritical" turbines and put into operation a unit capacity of 1 million kilowatts, it is first digital one million kilowatts of ultra-supercritical coal-fired units in China, also the company built the world's first use of seawater desulphurization one million kilowatts unit and the highest-efficiency parameters of 660,000 kilowatts ultra-supercritical coal-fired units. Following are logo of Huaneng company:

Image 3.1 Logo of Huaneng company

Source: http://www.hpi.com.cn/Pages/default.aspx

In 2014 Huaneng Group Co., Ltd（mother company of Huaneng company. is in 231 positions on the world Top 500 companies list.

3.2 History of Huaneng company

Huaneng Power International, Inc. is on was established on June 30, 1994 in the People's Republic of China ("China"), it is an incorporated joint venture Company. The company's registered address is Fuxingmennei Street, Beijing, China Huaneng Building on the 6th.

In 1994, Huaneng company Listed on the New York Stock Exchange. In 1998, Huaneng company Listed on Hong Kong stock exchange market.

In 2000, during restructuring Huaneng Group, Huaneng company merger the Shandong Huaneng, since after that merge Shandong Huaneng has become its one of core business part. this merger is biggest merge case between listed companies in Chinese mainland. Also it is one of most success merger for Huaneng company. The company was awarded the "China's leading power companies," the title of the State Power Corporation

In 2001, Huaneng company Listed on Shanghai stock exchange market.

In 2009, Huaneng company Invest 2 billion new coins to start polygene ration project which in Jurong Island, Singapore. The project will build a use of clean coal technology power plant, a desalination plant and wastewater treatment plant, it is Singapore's first coal and palm shell as a fuel for large-scale cogeneration projects.

In 2010, The company intends to non-public offering through the stock which is not exceed the net proceeds of 12 million A shares and get capital 8.6 billion yuan.at the same year, Huaneng company acquire Shandong Electric Power Group Company Yunnan Diandong Energy LLC, Yunnan Diandong Wang Energy Co., Ltd., the total purchase price is 8.625 billion yuan. Huaneng Power International, Inc. award by magazine being Buffett, the world competitiveness of enterprises Laboratory, the world's Economist magazine as the 2010 Joint (seventh) China 100 listed companies, ranked No. 35. In the same year, the magazine named "China's 25 most investment value of listed companies" award, ranked No. 6. Huaneng company is China's first implemented in New York, Hong Kong and Shanghai-listed power generation company

3.3 Power industry analysis in China

In this part, firstly we will describe general situation in Power industry in China, after that we will use some indicators to compare Huaneng company and its main competitors

3.31 General situation in power industry in China

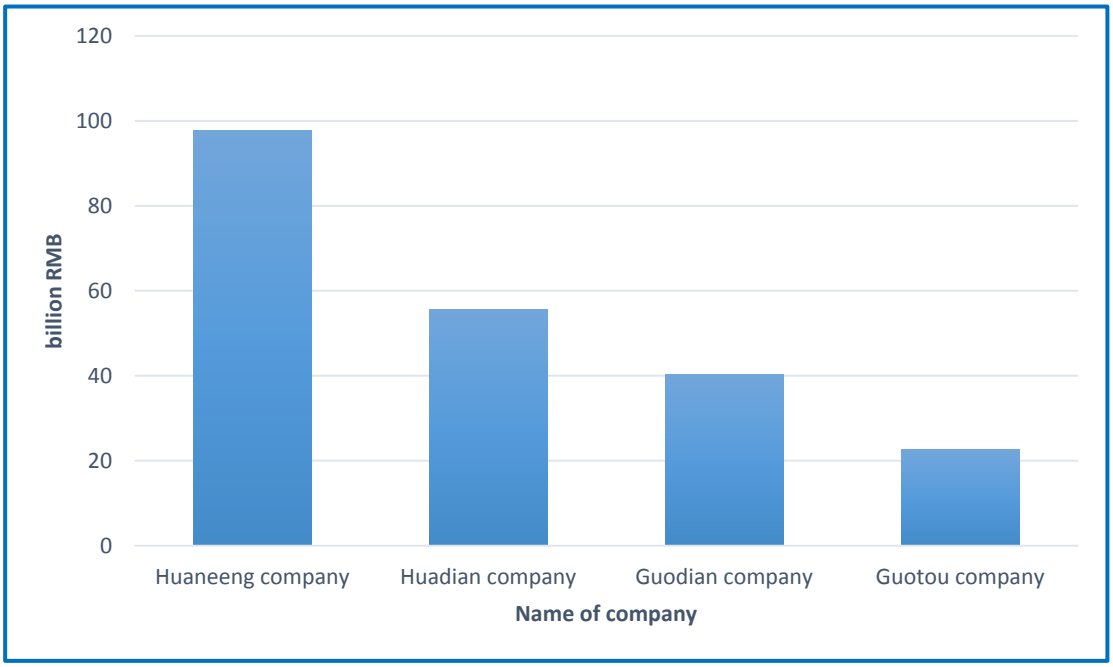
In China, power industry is typical monopolized industry, biggest company in power control by central government, some medium and small company control by local government. Until now , there are 62 big company in power industry list on A-share in China, the similar as Huaneng company, these company also provide development construction and management large-scale power plant in China, some of them are hydroelectric power industry, some of them are nuclear power industry, most

of them are thermal power generation .as a monopoly industry, it is very different for private or foreign capital to enter into this industry, most company in this industry has cooperation with foreign for technology development.

3.32 Huaneng company comparison with main competitors

We choose revenue and return on equity as our indictors to compare Huaneng company with the other three biggest power company in China, usually, the revenue represents company's scale, more revenue the company has, more capital or policy support may get from government. with higher ROE, company could be more easy get capital from capital market, also it could get good reputation, following it is:

Table 3.1 Four main power company's revenue in 2014

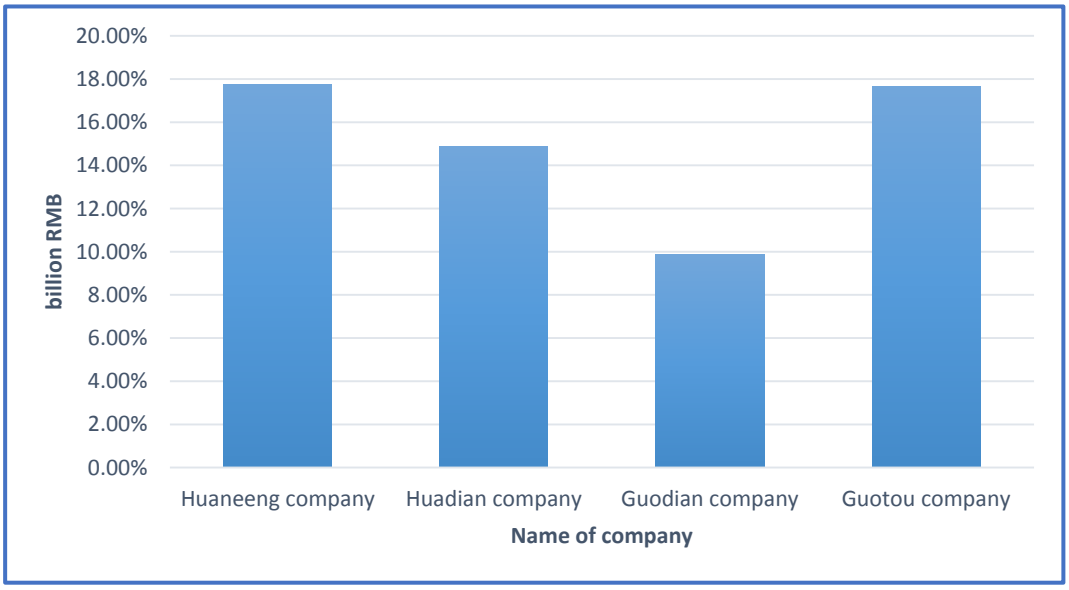


Source: finance.sina.com.cn

As we see in Table 3.1, Huaneng company has highest revenue compared with the other company, it is even two times higher than Guodian company and Three times higher than Guotou company. we could see Huaneng company's scale is biggest in power industry in China, that is one advantage for Huaneng company, capital and policy support is easy get from central government. It also indicated Huaneng own biggest market share in China.

Next we will compare ROE on these four biggest power company in China, following it is:

Table 3.2 Four main power company's ROE in 2014



Source: finance.sina.com.cn

As we see in table 3.2, Huaneng company with highest ROE compare with the other company, which means shareholder could get more dividend on buy share of Huaneng company, it is benefit for company to gain capital from capital market, that also the reason why Huaneng company with good reputation and the stock of Huaneng company is very popular in A-share market.

4 Valuation of Huaneng Power International Company under Risk

In this application part, the valuation of Huaneng Power International company will be performanced. The main goal of this part is to calculate the value of equity on 1.1.2015 of company under the risk. Firstly, we do financial analysis which ratio is component of ROE, after that we do pyramidal decomposition by using gradual method to evaluate which component has highest influence on ROE. In the third step, future FCFE is our goal. as (2.32) formula we describe before, there are some main parameters of FCFE, they are EAT, DEP, INV, ΔNWC and ΔS, the specific process of prediction these parameters will be introduced. In the fourth step, we use two stage DCF method to get value of equity of company. There are 10000 scenarios result of equity, so we make a distribution on this 10000 scenarios results. In the last step of this part, sensitive analysis will be described depend on $|g|$ (growth rate), probability distribution also in this step.

4.1 Financial analysis in component ratios of ROE

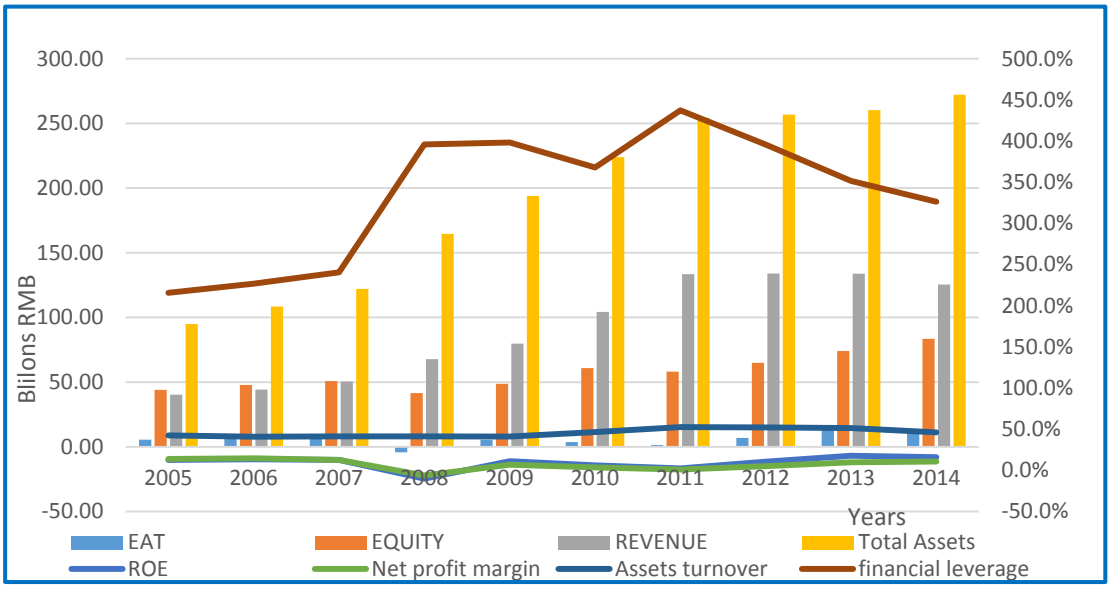
First step we do simply financial analysis in component ratios of ROE (one step decomposition), they are Net profit margin, Assets turnover and Financial leverage. We choose historical data from 2005 to 2014, following are the historical data and calculation result from the data in Table 4.1:

Table 4.1 Component ratios of ROE from 2005 to 2014(in billion RMB)

Reporting Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
EAT	5.57	6.45	6.42	-4.21	5.39	3.68	1.36	6.85	13.10	13.36
EQUITY	44.02	47.85	50.77	41.57	48.72	60.86	58.16	64.92	74.04	83.42
REVENUE	40.25	44.31	50.43	67.83	79.74	104.31	133.42	133.97	133.83	125.41
Total Assets	94.95	108.49	122.14	164.59	194.00	223.95	254.37	256.86	260.27	272.16
ROE	12.7%	13.5%	12.6%	-10.1%	11.1%	6.0%	2.3%	10.6%	17.7%	16.0%
Net profit margin	13.8%	14.5%	12.7%	-6.2%	6.8%	3.5%	1.0%	5.1%	9.8%	10.7%
Assets turnover	42.4%	40.8%	41.3%	41.2%	41.1%	46.6%	52.5%	52.2%	51.4%	46.1%
Financial leverage	215.7%	226.8%	240.6%	395.9%	398.2%	368.0%	437.4%	395.7%	351.5%	326.3%

From Table 4.1, we can general see that trend of Assets, Equity, Revenue, it is obvious keep increasing during these 10 years. in 2008, company make a negative profit which means company make a loss. we can dividend profitability ratios of this 10 years into three periods, first period from 2005 to 2007, during this period, company with high and stable EAT, ROE, net profit margin. The reason is that during this period, economic situation in China is really good, every year with around 9% increase speed, Huaneng Power company is one of the biggest Power company in China, it is high relate with China's economic situation, so company get big profit during this period. second period from 2008-2011,also similar situation as China's economic, in 2008 when economic crisis happened , company make a loss , after that , company keep recover from economic, still with profit, it can explain by that even increase speed of GDP in China decrease, but it is still increasing, third period from 2012 to 2014, after three to five years of economic crisis , economic situation in China is more stable with high develop speed, also during 2008-2012, in order to keep economic stable and increasing, Chinese government produce a serious policy, especially 4000 billion government expenditures , one of program is electricity construct , so get this chance, from 2012 to 2014 , company make a big development ,we can see it from ROE and EAT. The assets turnover keeps increasing during this period, which means company with more efficiency use of assets, the similar situation of Financial leverage, it means more and more company's assets come from debt, the cost of debt will be more. Following are trend in Chart:

Chart 4.1 Trend of Component ratios of ROE from 2005-2014



From the Chart 4.1, it is more specific see the trend as we describe before, next we need to find which ratio has biggest impact on ROE.

4.2 Pyramid decomposition and influence qualification of ROE

In this part, we need to find out which ratio has biggest influence on change of ROE, it is difficult for us to know it only by ratios and chart we describe before, so we use one method which is called gradual changes which describe by formula (2.6) and (2.7). Following are the results in table 4.2:

Table 4.2 Result of influence qualification

Year	a2005	a2006	Delta	Influence	order
a1=EAT/REV	0.13848	0.14545	0.00697	0.637%	2
a2=REV/ASSET	0.42389	0.40845	-0.01545	-0.485%	3
a3=ASSET/EQUITY	2.15711	2.26752	0.11041	0.656%	1
Year	a2006	a2007	Delta	Influence	order
a1=EAT/REV	0.14545	0.12725	-0.01821	-1.686%	3
a2=REV/ASSET	0.40845	0.41293	0.00448	0.129%	2
a3=ASSET/EQUITY	2.26752	2.40594	0.13842	0.727%	1
Year	a2007	a2008	Delta	Influence	order
a1=EAT/REV	0.12725	-0.06212	-0.18936	-18.813%	3
a2=REV/ASSET	0.41293	0.41209	-0.00084	0.012%	1
a3=ASSET/EQUITY	2.40594	3.95902	1.55308	-3.976%	2
Year	a2008	a2009	Delta	Influence	order
a1=EAT/REV	-0.06212	0.06763	0.12975	21.169%	1
a2=REV/ASSET	0.41209	0.41105	-0.00104	-0.028%	3
a3=ASSET/EQUITY	3.95902	3.98213	0.02311	0.064%	2
Year	a2009	a2010	Delta	Influence	order
a1=EAT/REV	0.06763	0.03528	-0.03235	-5.295%	3
a2=REV/ASSET	0.41105	0.46576	0.05471	0.769%	1
a3=ASSET/EQUITY	3.98213	3.67985	-0.30228	-0.497%	2
Year	a2010	a2011	Delta	Influence	order
a1=EAT/REV	0.03528	0.01023	-0.02506	-4.295%	3
a2=REV/ASSET	0.46576	0.52452	0.05877	0.221%	2
a3=ASSET/EQUITY	3.67985	4.37356	0.69371	0.372%	1
Year	a2011	a2012	Delta	Influence	order
a1=EAT/REV	0.01023	0.05115	0.04093	9.388%	1
a2=REV/ASSET	0.52452	0.52155	-0.00297	-0.067%	2
a3=ASSET/EQUITY	4.37356	3.95670	-0.41686	-1.112%	3
	a2012	a2013	Delta	Influence	order
a1=EAT/REV	0.05115	0.09792	0.04677	9.651%	1
a2=REV/ASSET	0.52155	0.51420	-0.00735	-0.285%	2
a3=ASSET/EQUITY	3.95670	3.51511	-0.44159	-2.223%	3
Year	a2013	a2014	Delta	Influence	order
a1=EAT/REV	0.09792	0.10657	0.00865	1.564%	1
a2=REV/ASSET	0.51420	0.46078	-0.05342	-2.001%	3
a3=ASSET/EQUITY	3.51511	3.26259	-0.25252	-1.240%	2

From Table 4.2 we can see that different years with different order, it is very different for us see which factors has biggest influence on ROE, following we make summarize and calculate stand derivation for every period result to compare which factors has biggest influence on ROE, following it is in Table 4.3:

Table 4.3 Result of gradual changes method

Year	EAT/REV	REV/ASSET	ASSET/EQUITY
2005-2006	0.637%	-0.485%	0.656%
2006-2007	-1.686%	0.129%	0.727%
2007-2008	-18.813%	0.012%	-3.976%
2008-2009	21.169%	-0.028%	0.064%
2009-2010	-5.295%	0.769%	-0.497%
2010-2011	-4.295%	0.221%	0.372%
2011-2012	9.388%	-0.067%	-1.112%
2012-2013	9.651%	-0.285%	-2.223%
2013-2014	1.564%	-2.001%	-1.240%
Standard deviation	11.284%	0.762%	1.544%

Gradual changes method describe component ratios which influence between two years, from Table 4.3, we can see two years as a period and it is more obvious that different between period and period, for example, from 2005-2006, Equity multiplier has biggest influence on ROE, from 2008-2009, net profit margin has biggest influence on ROE, so we get standard derivation of (Δa) , the result is 11.28%>1.54%>0.76%, which means Net profit margin has most biggest influence on change of ROE and it with most volatile so next part we will focus on predict Net profit margin.

4.3 Prediction of net profit margin

As we describe before, Net profit margin has biggest influence on change of ROE and the most volatile, in this part, we will try to find some way to prediction Net profit margin, before we make prediction Net profit margin, we should know history data of Net profit margin as follows in Table 4.4:

Table 4.4 History Net profit margin of Huaneng Power company

Reporting Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Net profit margin	13.8%	14.5%	12.7%	-6.2%	6.8%	3.5%	1.0%	5.1%	9.8%	10.7%

From table 4.4, we can see that the trend of Net profit margin is not obvious, and in 2008, Huaneng Power company make a loss, which means we cannot make a prediction by using Geometric Brownian Motion, because all number of this model must be positive, so we decide to try the Vasicek Model as we describe in formula (2.22),

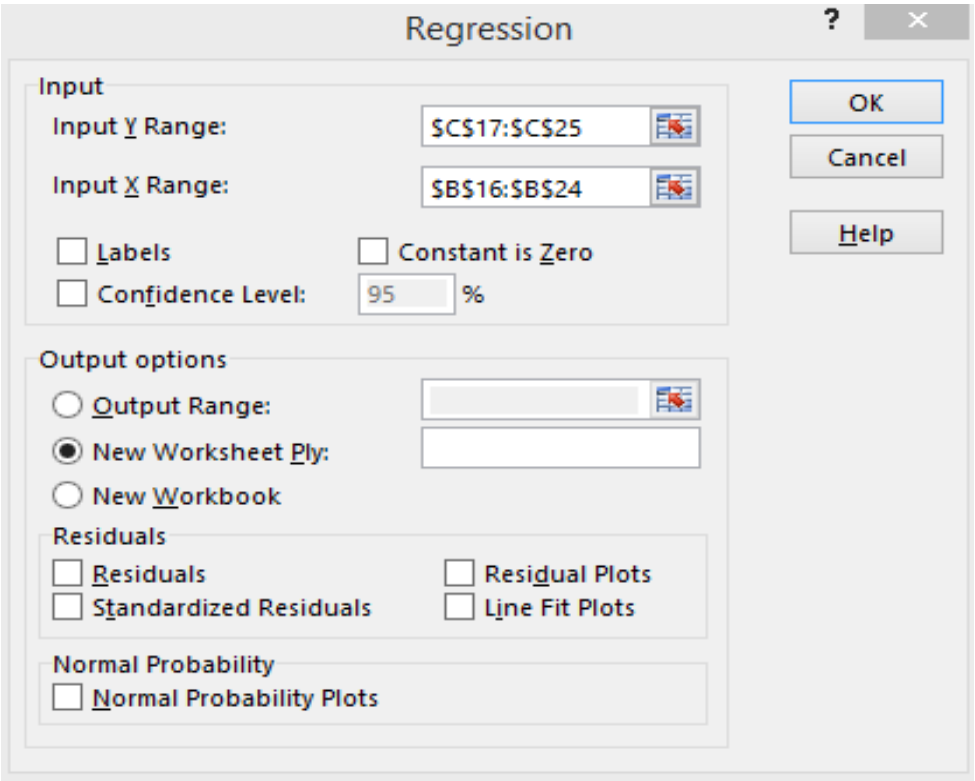
which number could be negative. Firstly, we should try if this model suitable for our data or not. following are checking result in Table 4.5

Table 4.5 Change of Net profit margin

Year	Net profit margin	ΔNet profit margin
2005	13.85%	
2006	14.55%	0.70%
2007	12.72%	-1.82%
2008	-6.21%	-18.94%
2009	6.76%	12.98%
2010	3.53%	-3.23%
2011	1.02%	-2.51%
2012	5.12%	4.09%
2013	9.79%	4.68%
2014	10.66%	0.87%

Next we will use regression method by excel data analysis, the process is that Data-Data analysis – Regression.

Image 4.1 Regression function



Input Y Range we put in ΔNet profit margin from 2006 to 2014, Input X Range we put in Net profit margin from 2005 to 2013, confidence level is 95%, and we find a new sheet to show the result. following are the result of our regression function

Image 4.2 Result of Regression function

Regression Statistics	
Multiple R	0.667791596
R Square	0.445945615
Adjusted R Square	0.366794989
Standard Error	0.068088434
Observations	9

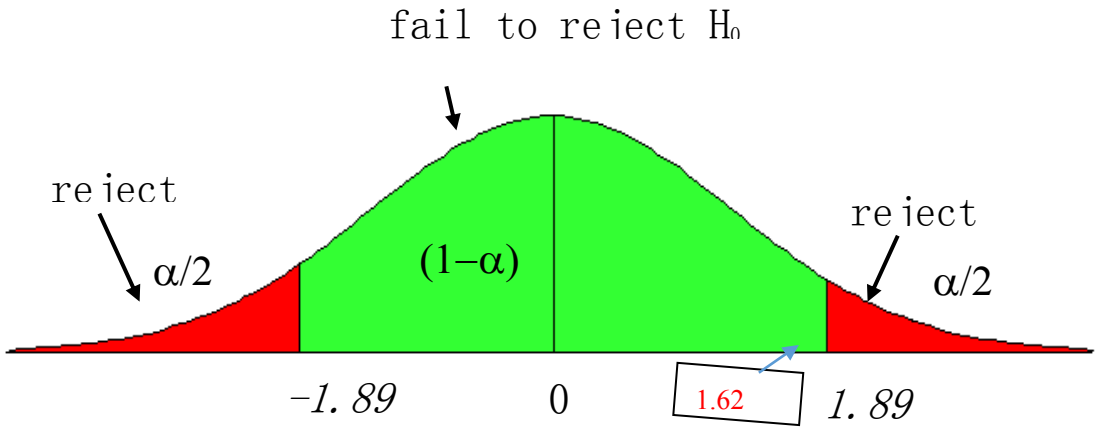
ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.026120064	0.02612	5.634139	0.04934181
Residual	7	0.032452244	0.004636		
Total	8	0.058572308			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0	Upper 95.0%
Intercept	0.053523494	0.033063428	1.618813	0.14952	-0.024659089	0.1317061	-0.02466	0.131706077
X Variable 1	-0.840263297	0.353998664	-2.37363	0.049342	-1.677337122	-0.003189	-1.67734	-0.00318947

After we get result of regression, we do t-static to exam parameters is significant or not, all the parameters in our model must be significance, if not, we couldn't use Vasicek Model. For example, we use t-statistics to exam our intercept. as we describe in formula (2.17). Firstly, using I.INV function in excel, we can easily get the critical value. Which are: Degree of freedom=9-1-1=7, T.INV (0.05,7) =-1.89, T.INV (0.05,7) =1.89, next we do the hypothesis:

H0: $\beta_0 = 0$ H1: $\beta_1 \neq 0$



T-statistics result as we describe before, when it is in tail, we reject H0, when it is not in tail, we fail to reject H0, we can see that 1.62 is not in the tail, so we fail to reject H0, which means interpret in our model is not significance. the same method as X variable 1. R-square represent how precise our model is, in our model it is only 45%, it is not precise, so we cannot use Vasicek Model. At last we decide to using model as

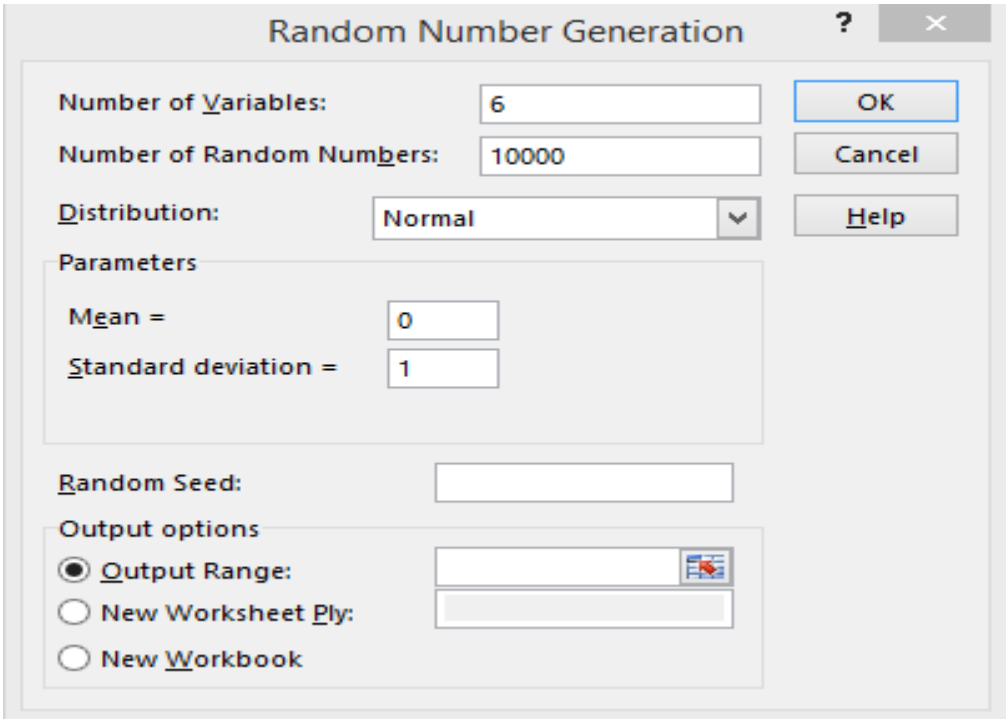
our main tool to make a prediction for net profit margin as we describe in formula (2.31). Considering the formula (2.11), we can easily to get stand derivation (σ). Following it is in Table 4.6:

Table 4.6 Parameters for simulating the random evolution of Net profit margin

Item	σ	Δt	N0	Z
Number	0.065	1	0.1066	/

σ is stand derivation of net profit margin during 10 years, Δt is interval, N0 is intimal Net profit margin, Z is random variable, Next we need to get random variable. In excel we do 10000 random variables for each year, the process is Data-Data analysis – Random variable generation. following are the figure of process:

Image 4.3 Random variable generation



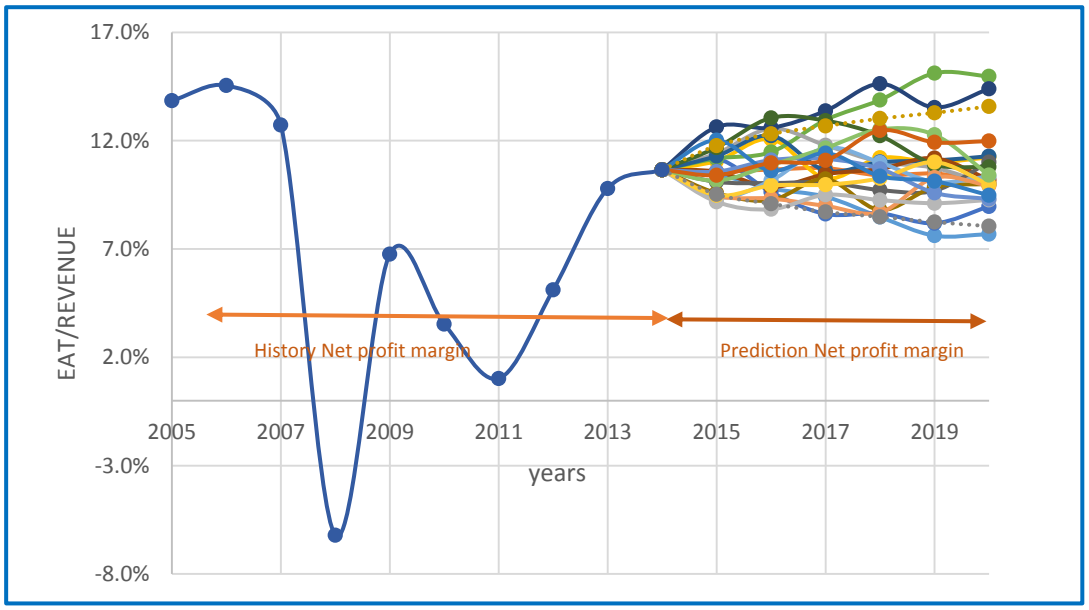
Number of variable is 6, we need prediction six years of Net profit margin, number of random number is 10000, we will prediction 10000 scenarios, it is normal distribution and stand derivation is 1, finally we need to choose output range, and click ok. After we get random variable, by using model and formula (2.31), we can make a prediction of Net profit margin future 6 years with 10000 scenarios, with too huge data, we couldn't put all in pages, in order to understanding prediction process, we choose 10 predictions randomly as an example in Table 4.7:

Table 4.7 Prediction of Net profit margin (10 scenarios)

Year	2014	2015	2016	2017	2018	2019	2020
Scenario 1	10.7%	10.4%	9.8%	9.4%	8.5%	7.6%	7.7%
Scenario 2	10.7%	10.6%	10.7%	10.7%	10.4%	10.5%	10.1%
Scenario 3	10.7%	11.1%	12.1%	10.3%	11.2%	11.0%	11.2%
Scenario 4	10.7%	11.2%	9.6%	8.6%	8.6%	8.2%	9.0%
Scenario 5	10.7%	11.2%	11.5%	13.0%	13.9%	15.1%	15.0%
Scenario 6	10.7%	11.4%	12.6%	11.8%	11.0%	10.7%	10.0%
Scenario 7	10.7%	11.3%	12.2%	10.6%	11.0%	11.1%	11.3%
Scenario 8	10.7%	10.6%	9.9%	10.5%	10.7%	11.2%	10.2%
Scenario 9	10.7%	10.1%	10.0%	10.1%	9.7%	9.7%	11.0%
Scenario 10	10.7%	9.6%	9.3%	10.2%	8.8%	9.9%	10.0%

The 2014 is our intimal year, 2015 to 2020 is our prediction year, in order to make it more clearly, we provide a chart as follow in Chart 4.2:

Chart 4.2 Prediction of Net profit margin



Due to 10 scenarios we choose, the future Net profit margin may go up or go down as it showed in Chart 4.2. until now we get prediction of Net profit margin for future six years, Next part we will make prediction of revenue for future six years.

4.4 Prediction of revenue

In this part, we will make prediction of revenue by regression, first of all, we to find some factors which has high relationship with Huaneng company's revenue. as one of biggest power company in China, it is logic that company's revenue has high relationship with GDP, we will focus on GDP and revenue by using regression function. first we need to get historical data. Following are historical data in Table 4.8:

Table 4.8 History revenue and GDP

Year	REVENUE	GDP	LOG(GDP)
2005	40.25	185895.80	5.27
2006	44.31	217656.60	5.34
2007	50.43	268019.40	5.43
2008	67.83	316751.70	5.50
2009	79.74	345629.20	5.54
2010	104.31	408903.00	5.61
2011	133.42	484123.50	5.68
2012	133.97	534123.00	5.73
2013	133.83	588018.80	5.77
2014	125.41	636138.70	5.80

(money units for revenue and GDP in billion RMB)

The process of regression is same as we have described in Image 4.1, Data- Data analysis- Regression, firstly we choose revenue and GDP, get the result, we discover that P-vale of intercept is bigger than 0.05. So we use LOG(GDP) instead of GDP. following are the final result between revenue and LOG(GDP).

Image 4.4 Result of regression function between revenue and log(GDP)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.962489413
R Square	0.92638587
Adjusted R Square	0.917184103
Standard Error	11.31146406
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	12881.26048	12881.26	100.67479	8.27769E-06
Residual	8	1023.593754	127.94922		
Total	9	13904.85424			

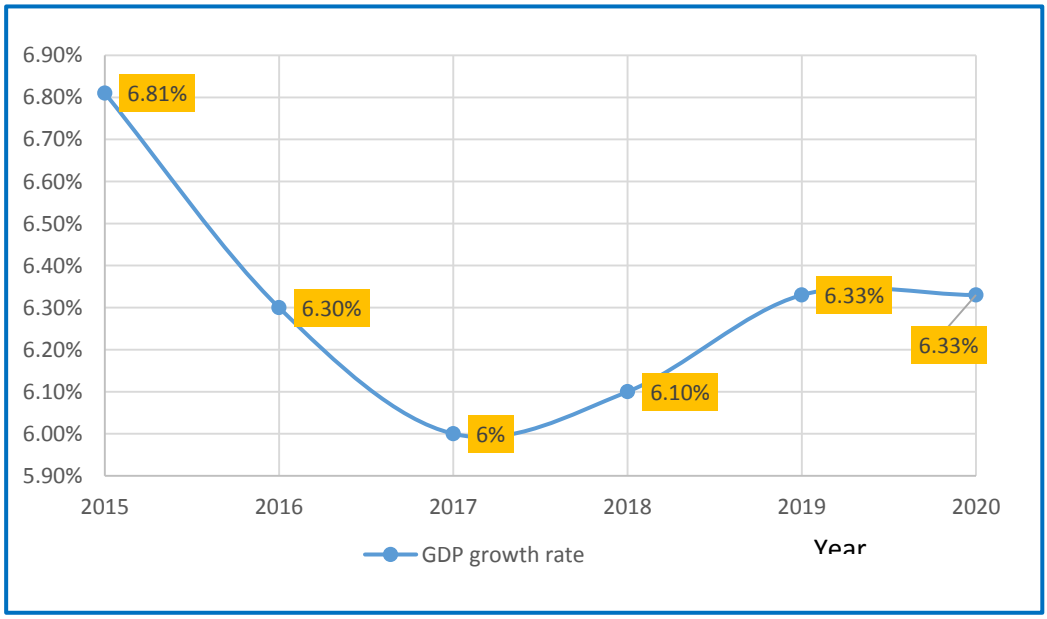
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	ower 95.0%	Upper 95.0%
Intercept	-1054.080092	114.214495	-9.228952	1.54E-05	-1317.45919	-790.701	-1317.459	-790.7009942
X Variable 1	205.7472453	20.50565603	10.033683	8.278E-06	158.4611177	253.03337	158.46112	253.0333729

As we describe in Image 4.2 and formula (2.17), in this regression model, P-value of intercept and X variable is small than 0.05, which means they are significance, the same as our model significance F. R-Square is 92% which means our model is accurate. our model can express as following:

$$Revenue=-1054+205.74*log(GDP) \quad (4.1)$$

From now on we get formula between revenue and GDP, next step is to get future GDP in China. following is prediction of China's GDP growth rate by World Bank :

Chart 4.3 Prediction of China's GDP growth rate by World Bank



Source:http://knoema.com/loqqwx/china-gdp-growth-forecast-2015-2020

As we get future GDP growth rate and formula between revenue and log(GDP), we can make a prediction of future GDP in China and future revenue of Huaneng Power company, result showing as follows in Table 4.9:

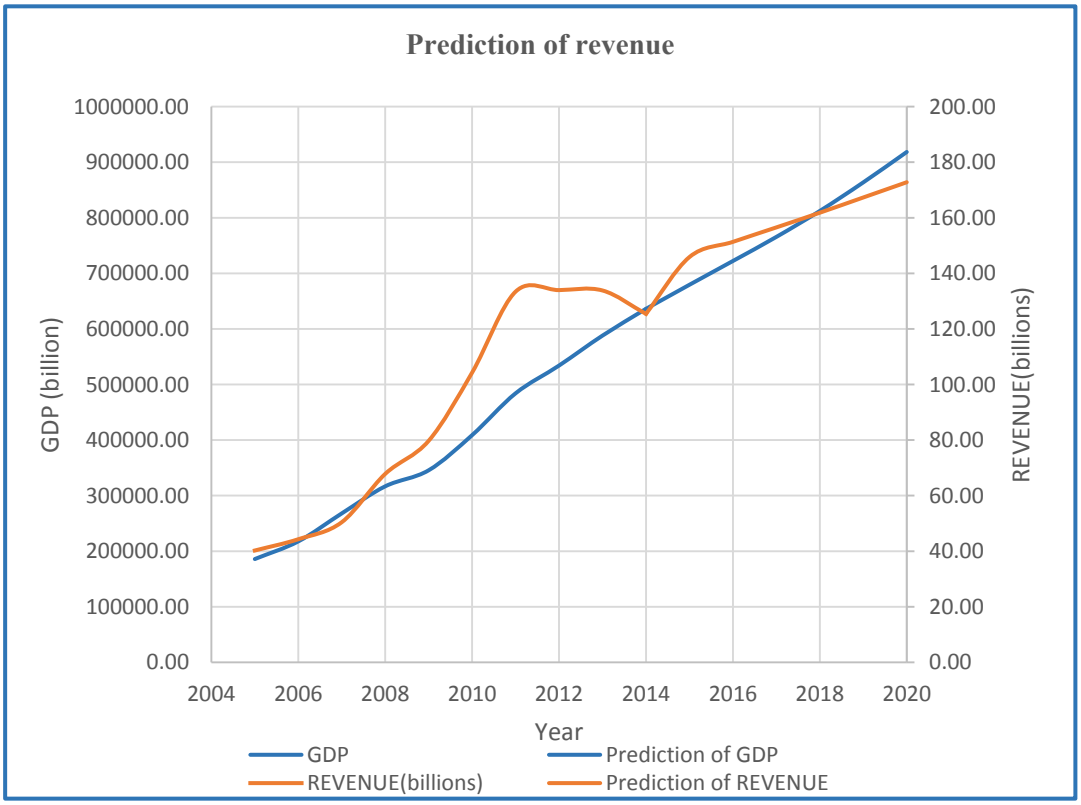
Table 4.9 Prediction of revenue

Year	Prediction of GDP growth rate	Prediction of GDP	Prediction of REVENUE
2015	6.8%	679459.75	145.87
2016	6.3%	722265.71	151.33
2017	6.0%	765601.65	156.54
2018	6.1%	812303.35	161.83
2019	6.3%	863722.16	167.31
2020	6.3%	918395.77	172.80

(money units for revenue and GDP in billion RMB)

In order to make more clearly, we will provide a chart to show historical and prediction GDP and revenue, following are the chart:

Chart 4.4 Prediction of revenue



From Chart 4.4, we can see that trend of GDP and revenue is very similar. Until now, we get prediction, next we will make prediction of EAT.

4.5 Prediction of earing after tax(EAT)

In 4.3, we have been made prediction of Net profit margin and we know future revenue of company, by using formula (2.37), we can get a result of EAT. The 10000 scenarios Net profit margin we have known, so 10000 scenarios EAT we can be calculated, we cannot show 10000 scenarios EAT in our pages, in order to show it clearly, we will make analysis the frequency of 10000 scenarios, the first step we need to know some key items as following in Table 4.10:

Table 4.10 Key items of frequency analysis

Year	2015	2016	2017	2018	2019	2020
Min	12.068	10.630	5.840	5.705	6.023	5.965
Max	19.341	22.370	26.184	28.085	31.933	33.616
Internal	20	20	20	20	20	20
Step	0.364	0.587	1.017	1.119	1.296	1.383

(Money units for Min and Max values are in billion RMB)

Min means minimum number of EAT in 10000 scenarios, the same as Max. we create 20 new internal for 10000 scenarios in each year, then by using excel function *"Min"* and *"Max"* we get lowest number and highest number of each year, by using formula:

$$\text{Step} = \frac{Max-Min}{Interval} \quad . \tag{4.2}$$

We can get steps. After we get all key items of frequency analysis, next we need do frequency analysis in excel, which means we need to get probability and frequency in 20 different internal for each year, here we provide 2015 as an example. Firstly, we list out 20 internal based on our step in 2015, after that we need to use excel function *"Frequency (data array, bins array)"* to get frequency in 2015. In *"data array"* we choose 10000 scenarios in 2015, in *"bins array"* we choose 20 intervals as we list before, at last we need to choose output area and press *"control shift enter"* together to get frequency. In each internal, the sum of our frequency must be equal to number of scenarios 10000, probability is calculated by frequency in each internal divided by 10000. The higher frequency and probability is, the more possible EAT would be in this internal, to make it more intuitive, we create table for each year, following are table:

Table 4.11 Frequency and Probability of EAT from 2015 to 2017

2015			2016			2017		
Interval	**F**	**P**	**Interval**	**F**	**P**	**Interval**	**F**	**P**
12.068	2	0.02%	10.630	1	0.01%	5.840	1	0.01%
12.431	5	0.05%	11.217	1	0.01%	6.857	0	0.00%
12.795	21	0.21%	11.804	9	0.09%	7.874	0	0.00%
13.159	65	0.65%	12.391	27	0.27%	8.891	0	0.00%
13.522	145	1.45%	12.978	80	0.80%	9.908	0	0.00%
13.886	258	2.58%	13.565	258	2.58%	10.926	3	0.03%
14.250	500	5.00%	14.152	513	5.13%	11.943	17	0.17%
14.613	813	8.13%	14.739	871	8.71%	12.960	152	1.52%
14.977	1062	10.62%	15.326	1258	12.58%	13.977	559	5.59%
15.341	1319	13.19%	15.913	1543	15.43%	14.994	1164	11.64%
15.705	1424	14.24%	16.500	1505	15.05%	16.012	1851	18.51%
16.068	1369	13.69%	17.087	1339	13.39%	17.029	2070	20.70%
16.432	1130	11.30%	17.674	1048	10.48%	18.046	1834	18.34%
16.796	854	8.54%	18.261	718	7.18%	19.063	1283	12.83%
17.159	510	5.10%	18.848	460	4.60%	20.080	657	6.57%
17.523	283	2.83%	19.435	220	2.20%	21.098	273	2.73%
17.887	135	1.35%	20.022	97	0.97%	22.115	107	1.07%
18.250	57	0.57%	20.609	37	0.37%	23.132	24	0.24%
18.614	35	0.35%	21.196	7	0.07%	24.149	3	0.03%
18.978	10	0.10%	21.783	6	0.06%	25.167	1	0.01%
19.341	3	0.03%	22.370	2	0.02%	26.184	1	0.01%
Sum	**10000**	**1**	**Sum**	**10000**	**1**	**Sum**	**10000**	**1**

(Money units for interval in billion RMB)

Table 4.12 Probability and Frequency of EAT from 2018 to 2020

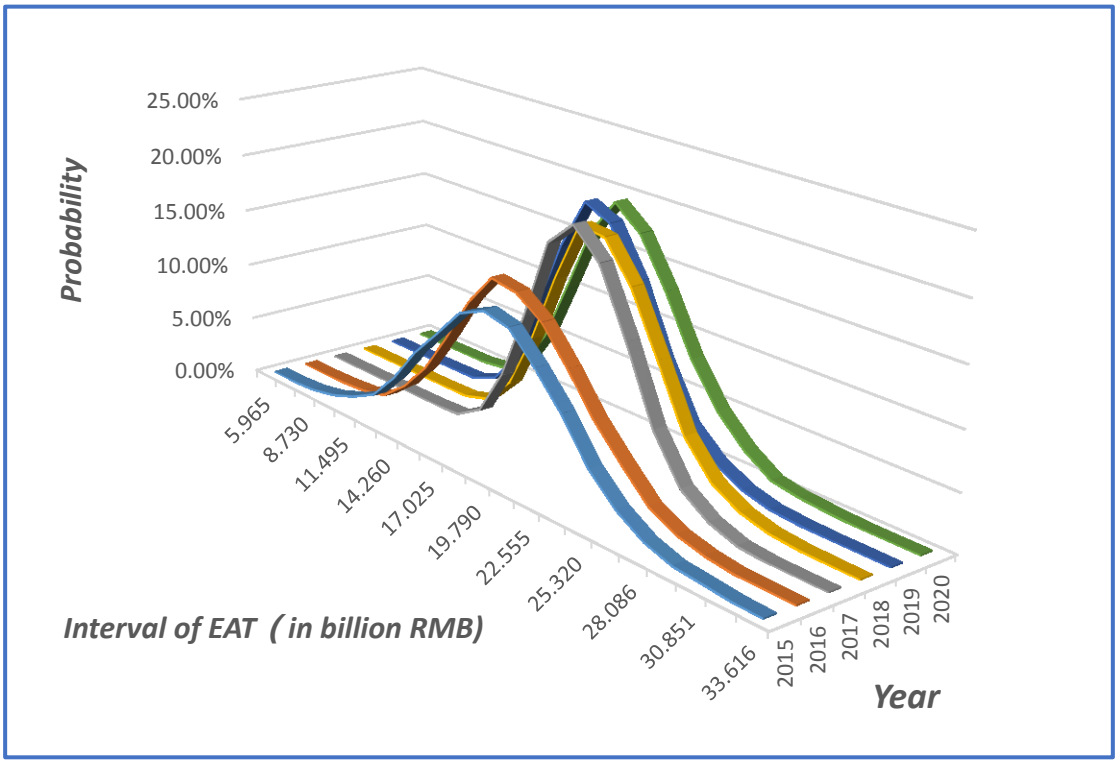
2018			2019			2020		
Interval	**F**	**P**	**Interval**	**F**	**P**	**Interval**	**F**	**P**
5.705	1	0.01%	6.023	1	0.01%	5.965	1	0.01%
6.824	0	0.00%	7.318	0	0.00%	7.347	0	0.00%
7.943	0	0.00%	8.614	0	0.00%	8.730	0	0.00%
9.062	0	0.00%	9.909	2	0.02%	10.112	3	0.03%
10.181	2	0.02%	11.205	10	0.10%	11.495	34	0.34%
11.300	9	0.09%	12.500	101	1.01%	12.877	151	1.51%
12.419	76	0.76%	13.796	383	3.83%	14.260	508	5.08%
13.538	318	3.18%	15.091	955	9.55%	15.643	1045	10.45%
14.657	810	8.10%	16.387	1545	15.45%	17.025	1600	16.00%
15.776	1411	14.11%	17.682	1991	19.91%	18.408	1929	19.29%
16.895	1931	19.31%	18.978	1882	18.82%	19.790	1735	17.35%
18.014	1904	19.04%	20.273	1470	14.70%	21.173	1322	13.22%
19.133	1575	15.75%	21.569	888	8.88%	22.555	828	8.28%
20.252	1057	10.57%	22.864	425	4.25%	23.938	472	4.72%
21.371	521	5.21%	24.160	215	2.15%	25.320	236	2.36%
22.490	234	2.34%	25.455	89	0.89%	26.703	76	0.76%
23.609	98	0.98%	26.751	28	0.28%	28.086	37	0.37%
24.728	34	0.34%	28.046	10	0.10%	29.468	16	0.16%
25.847	12	0.12%	29.342	2	0.02%	30.851	3	0.03%
26.966	5	0.05%	30.637	2	0.02%	32.233	2	0.02%
28.085	2	0.02%	31.933	1	0.01%	33.616	2	0.02%
Sum	**10000**	**1**	**Sum**	**10000**	**1**	**Sum**	**10000**	**1**

(Money units for interval in billion RMB)

From Table 4.11 and 4.12 we provide above, it is easy to get which interval of EAT is most frequency, in 2015 most frequency of EAT is in interval 15.705 to 16.068. In 2016 most frequency of EAT is in interval 15.913 to 16.600. In 2017 most frequency of EAT is in interval 16.012 to 17.029. In 2018 most frequency of EAT is in interval 16.895 to 18,014. In 2019 most frequency of EAT is in interval 17.682 to 18,978. In 2020 most frequency of EAT is in interval 18.408 to 19.790.

Following we provide a chart which can compare these data together. the year 2007 to 2020 with the highest probability is around 20%, In the year 2015, the highest probability is lowest compare with the other years.

Chart 4.10 Probability distribution of EAT in each year



4.6 Prediction of free cash flow to equity (FCFE)

From now on we have known EAT, in this part we will prediction rest key parameters of FCFE, they are INV (investment), DEP (depreciation), ΔNWC (change of net working capital), ΔS (the difference debt drawing).

4.6.1 Prediction investment outlay(INV) and depredation(DEP)

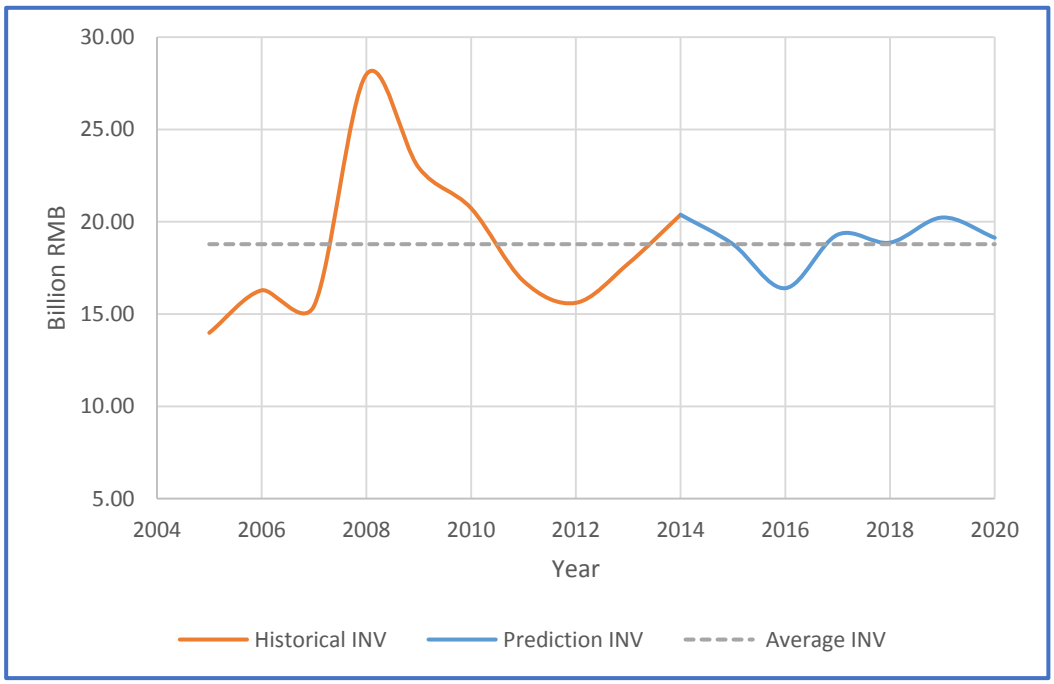
In this we will make prediction on INV and DEP, one important items about INV and DEP is fixed assets, DEP could be one part of fixed assets, INV could be this year fixed assets minus previous fixed assets. firstly, we focus on INV, following are history data of INV and fixed assets in Table 4.13:

Table 4.13 Historical INV and Fixed Assets (in billion RMB)

Year	Fixed Assets	INV
2005	56.17	13.98
2006	75.86	16.29
2007	76.06	15.44
2008	91.29	27.99
2009	108.77	22.93
2010	123.65	20.73
2011	154.81	16.79
2012	159.36	15.61
2013	160.93	17.73
2014	169.74	20.38

From table 4.13, we can see that Fixed Assets with increasing trend, INV is with big fluctuate, there is no trend on INV, but it is fluctuating around its average with the volatility small and small. so we an assumption, INV will be around its history average and with less volatility, which means more closely to its history average, we choose some data around average as our prediction of INV, in order to make it more visible, we provide a chart, following it is :

Chart 4.11 Prediction of INV



This year's fixed assets minus previous years fixed assets could get INV theoretically, as we get INV of future years, we can calculate fixed assets for future years. Following is result we get in Table 4.14:

Table 4.14 Prediction of INV and fixed assets (billion RMB)

Year	Fixed Assets	INV
2015	188.531	18.8
2016	204.931	16.4
2017	224.231	19.3
2018	243.101	18.87
2019	263.331	20.23
2020	282.464	19.13

As we describe before, depreciation is portion of fixed assets, so we can prediction DEP by future fixed assets, following are result from historical in Table 4.15:

Table 4.15 Historical Depreciation and fixed assets (in billion RMB)

Year	Fixed Assets	Depreciations	Proportion of DEP on Fixed Assets
2005	56.17	5.83	10.38%
2006	75.86	6.40	8.44%
2007	76.06	7.11	9.34%
2008	91.29	7.53	8.25%
2009	108.77	9.10	8.37%
2010	123.65	10.18	8.23%
2011	154.81	11.72	7.57%
2012	159.36	10.91	6.85%
2013	160.93	11.27	7.00%
2014	169.74	11.72	6.91%
Average portion			8.13%

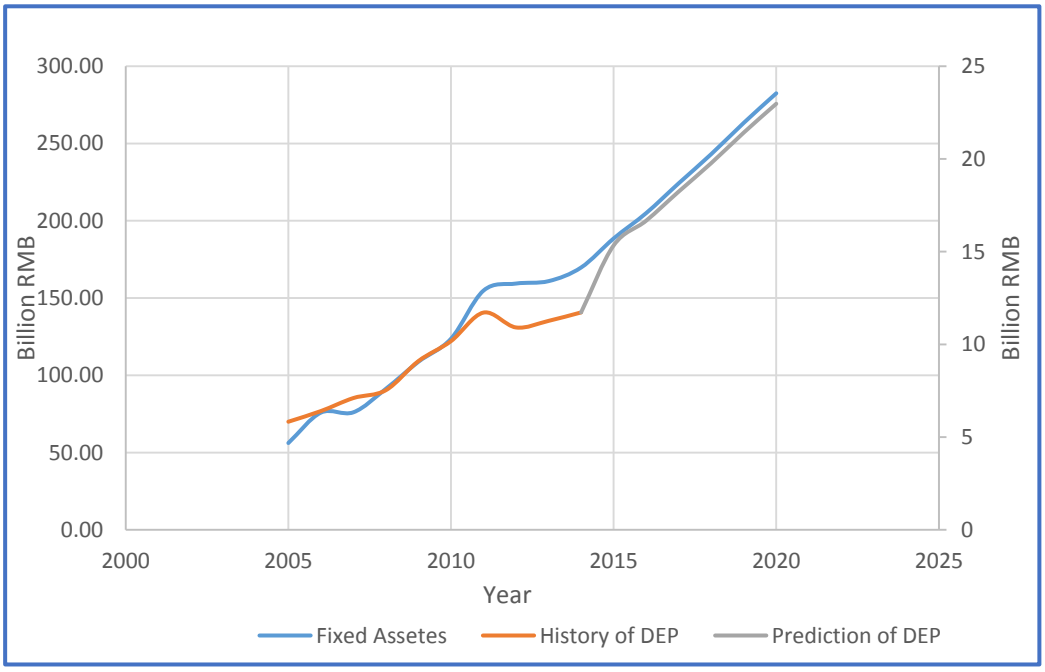
As we get average portion between fixed assets and DEP, we can assumption that in the future, DEP will same as 8.13% of fixed assets. We have made prediction for fixed assets, so the same as DEP, following is result in Table 4.16:

Table 4.16 Prediction Depreciation (in billion RMB)

Year	Prediction of fixed assets	Prediction of Depreciation
2015	188.53	15.33
2016	204.93	16.67
2017	224.23	18.24
2018	243.10	19.77
2019	263.33	21.42
2020	282.46	22.98

In order to make it more clarity, following we providing a chart including fixed assets and DEP:

Chart 4.12 Prediction Depreciation



4.6.2 Prediction of change in net working capital(ΔNWC)

Depend on formula (2.39)，we can get working capital, after that we can get change of net working capital. In this part we will use regression function, one regression model is between revenue and current assets, revenue would be independent variable, current assets would be dependent variable, the other model is revenue and current liabilities, log(revenue) would be independent variable, current assets would be dependent variable, firstly we need to get historical data, following it is in Table 4.17:

Table 4.17 Historical revenue, current assets and current liabilities (in billion RMB)

Financial Year	Current Assets	Revenue	Log(Rev)	Current Liabilities
2005	12.063	40.248	1.605	21.919
2006	13.126	44.313	1.647	25.306
2007	18.551	50.435	1.703	30.532
2008	20.018	67.825	1.831	51.652
2009	21.995	79.742	1.902	56.557
2010	28.795	104.308	2.018	80.056
2011	34.404	133.421	2.125	93.765
2012	35.145	133.967	2.127	91.283
2013	33.524	133.833	2.127	97.183
2014	36.592	125.407	2.098	102.294

From historical data and process how to use regression function in Image 4.1, we can get following result:

Image 4.5 Regression function between revenue and current assets

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.983520896
R Square	0.967313352
Adjusted R Square	0.963227521
Standard Error	1.802060368
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	768.8213903	768.82139	236.74826	3.16299E-07
Residual	8	25.97937256	3.2474216		
Total	9	794.8007629			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3.941158459	1.50785632	2.6137493	0.0309495	0.46403555	7.41828137	0.46403555	7.418281368
X Variable 1	0.235141621	0.015282208	15.386626	3.163E-07	0.199900786	0.27038246	0.199900786	0.270382457

Image 4.6 Regression function between revenue and current liabilities

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.989236747
R Square	0.978589341
Adjusted R Square	0.975913009
Standard Error	4.918891686
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	8846.978246	8846.9782	365.6456746	5.79605E-08
Residual	8	193.5639634	24.195495		
Total	9	9040.54221			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-220.7147182	15.02536699	-14.68947	4.53143E-07	-255.3632766	-186.0662	-255.3632766	-186.0661598
X Variable 1	148.9739415	7.790764706	19.121864	5.79605E-08	131.0084059	166.93948	131.0084059	166.9394771

In first regression, both P-value is small than 0.05 and significance F is also small than 0.05, which means this model is significance, R-square is 96%, which means this model is very precise. The same as model two, we can express these two models as following:

$$Current\ Assets=3.94+0.235*Revenue \quad (4.3)$$

$$Current\ Liability=-220+148.97*log(Revenue) \quad (4.4)$$

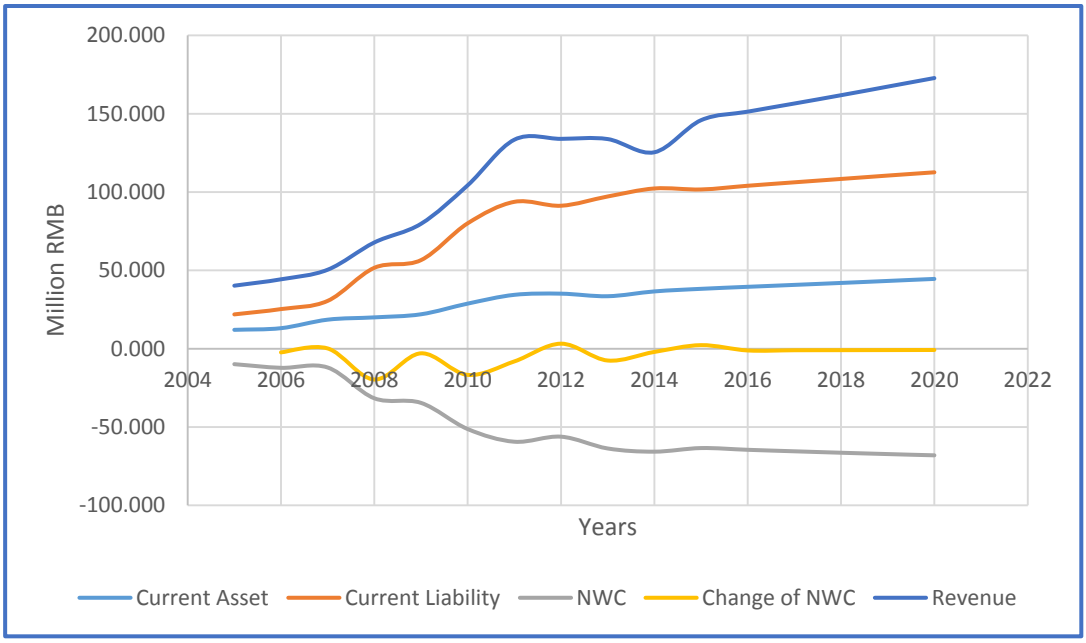
as we get this two regression and the revenue which we prediction before, we can get future current assets and current liabilities, after we get change of net working capital, following it is in Table 4.18:

Table 4.18 Prediction of change in net working capital (in billion RMB)

Year	Current Asset	Current Liability	NWC	Change of NWC
2014	36.592	102.294	-65.702	
2015	38.242	101.661	-63.419	2.283
2016	39.525	104.038	-64.512	-1.093
2017	40.750	106.226	-65.477	-0.964
2018	41.994	108.377	-66.383	-0.907
2019	43.283	110.533	-67.250	-0.867
2020	44.573	112.620	-68.047	-0.797

In order to looking more visual, we providing a chart, following it is:

Chart 4.17 Prediction of change in net working capital



4.6.3 Prediction of net payment (ΔS)

Depending formula (2.41), we can get ΔS, so firstly we need to get repayment of borrowing and new borrowing received, these two items depend on total loans, in this part we use weight moving average to prediction total loans, following are result in Table 4.19:

Table 4.19 Prediction total loans (in billion RMB)

Year	Totals loans	increase speed	weight
2005	35.443		
2006	42.922	21.1%	0.05
2007	45.109	5.1%	0.05
2008	87.773	94.6%	0.05
2009	95.997	9.4%	0.05
2010	109.232	13.8%	0.1
2011	123.824	13.4%	0.1
2012	100.007	-19.2%	0.2
2013	98.451	-1.6%	0.2
2014	101.167	2.8%	0.2
2015	106.849		5.616%
2016	112.849		
2017	119.186		
2018	125.879		
2019	132.948		
2020	140.414		

As we prediction future total loans, repayment of loans would be a part of total loans. We will use regression model to get repayment of loans. After we get two items, depending on formula (2.42), we can get new borrowing received, at last, ΔS would be calculated, following are historical data and prediction result in Table 4.20:

Table 4.20 Historical repayment of loans and borrowing received (in billion RMB)

Year	Repayment of Borrowings	log (total loans)	New borrowing received
2005	16.955	1.550	21.955
2006	21.561	1.633	24.482
2007	28.265	1.654	32.855
2008	54.738	1.943	94.353
2009	73.388	1.982	74.841
2010	71.293	2.038	72.406
2011	90.494	2.093	86.395
2012	108.316	2.000	67.720
2013	88.758	1.993	46.405
2014	94.119	2.005	71.150

Next we use regression function to prediction future repayment of loans.

Image 4.7 Regression function between Log(loans) and repayment of loans

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.913645342
R Square	0.83474781
Adjusted R Square	0.814091286
Standard Error	14.1538698
Observations	10

ANOVA

	df	SS	MS	F	Significance F
Regression	1	8095.58887	8095.58887	40.4108562	0.000218973
Residual	8	1602.656242	200.3320303		
Total	9	9698.245112			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-223.2731728	45.53498782	-4.903332216	0.00118876	-328.277043	-118.269303	-328.277043	-118.2693025
X Variable 1	152.4820296	23.98665219	6.356953375	0.00021897	97.16871045	207.7953487	97.16871045	207.7953487

From Image 4.7 we can see both P-value small than 0.05, the same as significance F, R Square is 83.5%, we could see this regression is significance, following it is:

$$Repayment\ of\ loans = -223.27 + 152.48 * log(loans) \quad (4.5)$$

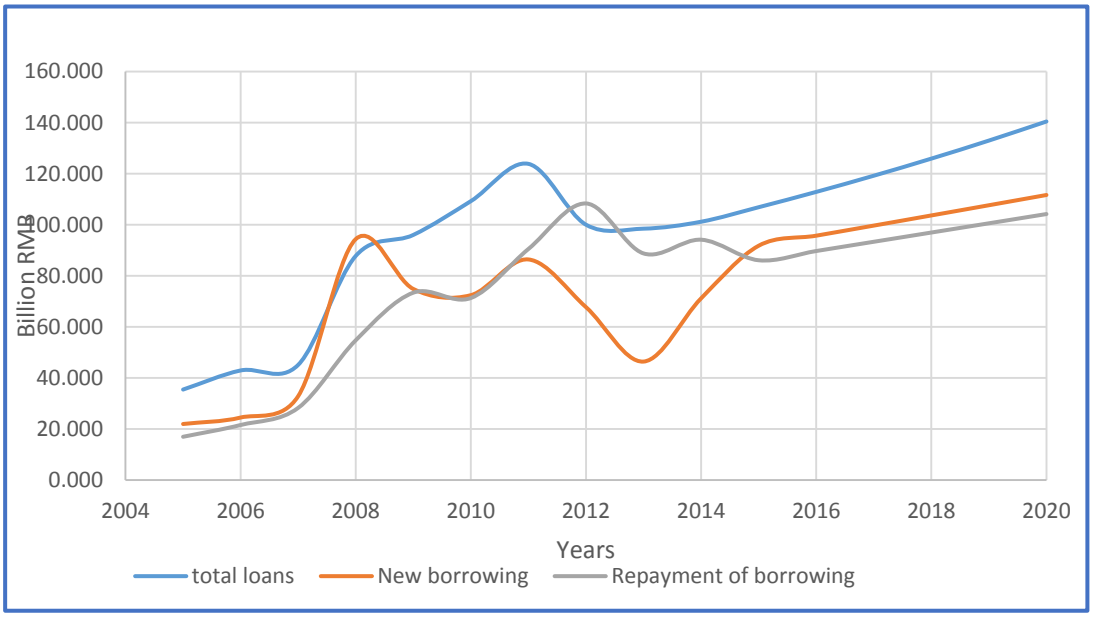
By using this regression, we can get repayment of loans, after that, depend on formula (2.42), we could get new borrowing received, when we get new borrowing received, by using formula (2.41), we could get ΔS, following are result in Table 4.21:

Table 4.21 Prediction ΔS (in billion RMB)

Year	Total loans	Repayment of Borrowings	New borrowing received	ΔS
2015	106.849	86.078	91.759	5.681
2016	112.849	89.696	95.696	6.000
2017	119.186	93.314	99.651	6.337
2018	125.879	96.932	103.625	6.693
2019	132.948	100.550	107.619	7.069
2020	140.414	104.168	111.634	7.466

In order to looking more visual, we providing a chart, following it is:

Chart 4.18 Prediction ΔS



4.6.4 Prediction of free cash flow to equity（FCFE）

From now on we get all parameters of FCFE, by using formula (2.34), we can get FCFE for each year, with 10000 scenarios of EAT, we also get 10000 scenarios of FCFE, and then we make probability distribution for 10000 scenarios for FCFE. Following are items we need to know in Table 4.22:

Table 4.22 Items for probability distribution

Year	2015	2016	2017	2018	2019	2020
Min	12.014	17.993	12.080	14.208	15.147	18.070
Max	19.287	29.732	32.424	36.588	41.057	45.721
Internal	20	20	20	20	20	20
Step	0.364	0.587	1.017	1.119	1.296	1.383

(money units for min and max are in billion RMB)

Min means minimum number of FCFE in 10000 scenarios, the same as Max. we create 20 new internal for 10000 scenarios in each year, then by using excel function *"Min"* and *"Max"* we get lowest number and highest number of each year, by using formula 4.1, we can get step, after we get all key items of frequency analysis, next we need do frequency analysis in excel, which means we need to get probability and frequency in 20 different internal for each year. We use the same process as we describe in EAT, in each internal, the sum of our frequency must be equal to number of scenarios

10000, probability is calculated by frequency in each internal divided by 10000. The higher frequency and probability is, the more possible EAT would be in this internal, following are result, we provide it by Table 4.23 and Table 4.24

Table 4.23 Frequency and Probability distribution of FCFE from 2015 to 2017

2015			2016			2017		
Interval	**F**	**P**	**Interval**	**F**	**P**	**Interval**	**F**	**P**
12.014	2	0.02%	17.993	1	0.01%	12.080	1	0.01%
12.378	5	0.05%	18.580	1	0.01%	13.097	0	0.00%
12.741	21	0.21%	19.167	9	0.09%	14.114	0	0.00%
13.105	65	0.65%	19.754	27	0.27%	15.131	0	0.00%
13.469	145	1.45%	20.341	80	0.80%	16.149	0	0.00%
13.832	258	2.58%	20.928	258	2.58%	17.166	3	0.03%
14.196	500	5.00%	21.515	513	5.13%	18.183	17	0.17%
14.560	813	8.13%	22.102	871	8.71%	19.200	152	1.52%
14.923	1062	10.62%	22.689	1258	12.58%	20.217	559	5.59%
15.287	1319	13.19%	23.275	1543	15.43%	21.235	1164	11.64%
15.651	1424	14.24%	23.862	1505	15.05%	22.252	1851	18.51%
16.014	1369	13.69%	24.449	1339	13.39%	23.269	2070	20.70%
16.378	1130	11.30%	25.036	1048	10.48%	24.286	1834	18.34%
16.742	854	8.54%	25.623	718	7.18%	25.303	1283	12.83%
17.105	510	5.10%	26.210	460	4.60%	26.321	657	6.57%
17.469	283	2.83%	26.797	220	2.20%	27.338	273	2.73%
17.833	135	1.35%	27.384	97	0.97%	28.355	107	1.07%
18.196	57	0.57%	27.971	37	0.37%	29.372	24	0.24%
18.560	35	0.35%	28.558	7	0.07%	30.389	3	0.03%
18.924	10	0.10%	29.145	6	0.06%	31.407	1	0.01%
19.287	3	0.03%	29.732	2	0.02%	32.424	1	0.01%
Sum	**10000**	**1**	**Sum**	**10000**	**1**	**Sum**	**10000**	**1**

(money units for interval in billion RMB)

Table 4.24 Frequency and Probability distribution of FCFE from 2018 to 2020

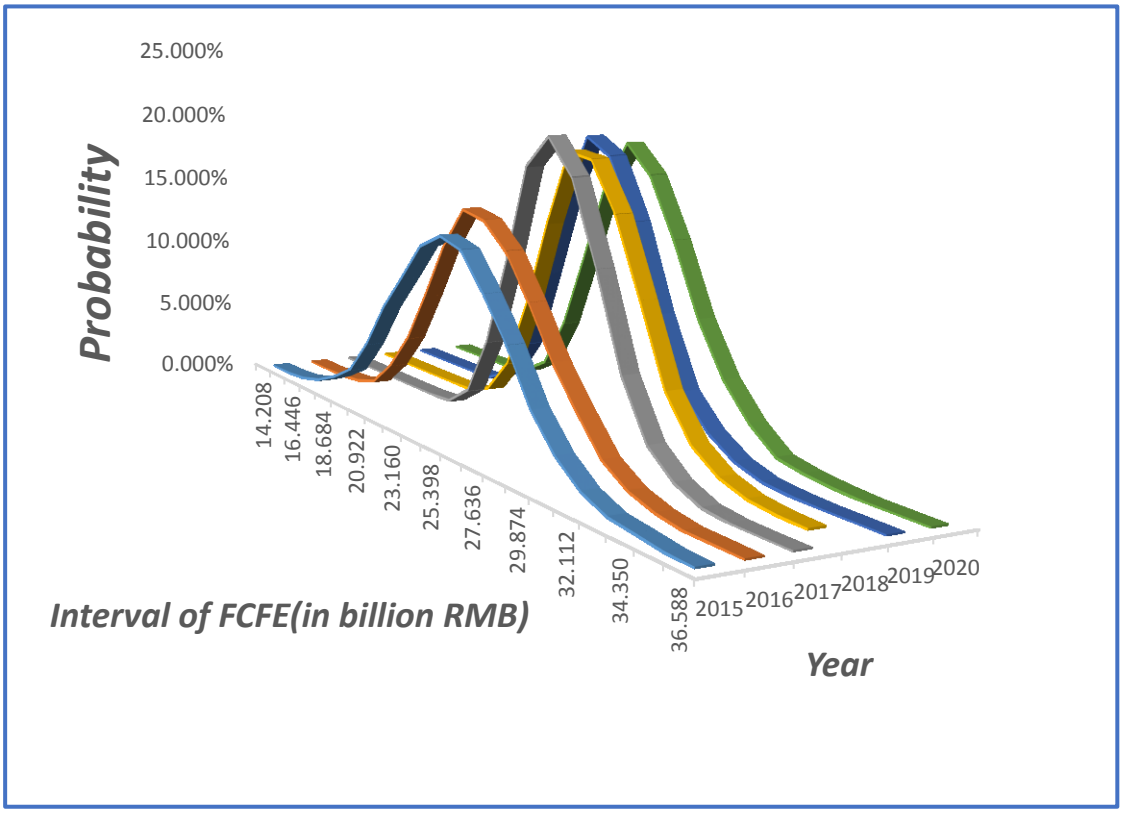
2018			2019			2020		
Interval	**F**	**P**	**Interval**	**F**	**P**	**Interval**	**F**	**P**
14.208	1	0.01%	15.147	1	0.01%	18.070	1	0.01%
15.327	0	0.00%	16.443	0	0.00%	19.453	0	0.00%
16.446	0	0.00%	17.738	0	0.00%	20.835	0	0.00%
17.565	0	0.00%	19.034	2	0.02%	22.218	3	0.03%
18.684	2	0.02%	20.329	10	0.10%	23.600	34	0.34%
19.803	9	0.09%	21.625	101	1.01%	24.983	151	1.51%
20.922	76	0.76%	22.920	383	3.83%	26.365	508	5.08%
22.041	318	3.18%	24.216	955	9.55%	27.748	1045	10.45%
23.160	810	8.10%	25.511	1545	15.45%	29.130	1600	16.00%
24.279	1411	14.11%	26.807	1991	19.91%	30.513	1929	19.29%
25.398	1931	19.31%	28.102	1882	18.82%	31.896	1735	17.35%
26.517	1904	19.04%	29.398	1470	14.70%	33.278	1322	13.22%
27.636	1575	15.75%	30.693	888	8.88%	34.661	828	8.28%
28.755	1057	10.57%	31.989	425	4.25%	36.043	472	4.72%
29.874	521	5.21%	33.284	215	2.15%	37.426	236	2.36%
30.993	234	2.34%	34.580	89	0.89%	38.808	76	0.76%
32.112	98	0.98%	35.875	28	0.28%	40.191	37	0.37%
33.231	34	0.34%	37.171	10	0.10%	41.573	16	0.16%
34.350	12	0.12%	38.466	2	0.02%	42.956	3	0.03%
35.469	5	0.05%	39.762	2	0.02%	44.338	2	0.02%
36.588	2	0.02%	41.057	1	0.01%	45.721	2	0.02%
Sum	**10000**	**1**	**Sum**	**10000**	**1**	**Sum**	**10000**	**1**

(money units for interval in billion RMB)

From Table 4.23 and 4.24 we provide above, it is easy to get which interval of FCFE is most frequency, in 2015 most frequency of FCFE is in interval 15.651 to 16.014. In 2016 most frequency of FCFE is in interval 23.725 to 23.862. In 2017 most frequency of FCFE is in interval 22.252 to 23.269. In 2018 most frequency of FCFE is in interval 25.398 to 26.517. In 2019 most frequency of FCFE is in interval 26.807 to 28.102. In 2020 most frequency of FCFE is in interval 30.513 to 31.896

Following we provide a chart 4.16 which can compare these data together. From 2007 to 2020 the highest probability is around 20%, In the year 2015, the highest probability is lowest compare with the other years.

Chart 4.16 Probability of FCFE in each year



4.7 Calculation of valuation

In this part, we will calculate equity value of company, until now, we get 10000 scenarios FCFE for future five years, next we need to get cost of equity, we can use CAPM model to get cost of equity according to formula (2.52), following are parameters and cost of equity which we get in Table 4.25:

Table 4.25 Calculation cost of equity

Items	Result
unleveraged beta	0.66
Total equity risk premium	6.65%
Yield of 10 years' government bond	3.38%
Yield of 50 years' government bond	5.23%
D/E	2.36
tax rate	12.63%
leverage beta	2.11
E(RE)1	17.44%
E(RE)2	19.29%

We use return of government bond as risk free rate. To first phrase, we will use the yield of 10 years government which is 3.38% and to second phrase, we use yield of 50 years government bond which is 5.23%。we can check the website of Damodaran Online to find the specific unleveraged β coefficient for electricity industry and D/E is 10 years average D/E from historical data, by using formula (2.53)， we can get leverage for company, total equity risk premium is also check from website Damodaran. After we use CAPM model to get two stage cost of equity, first stage is 17.44%, second stage is 19.29%.

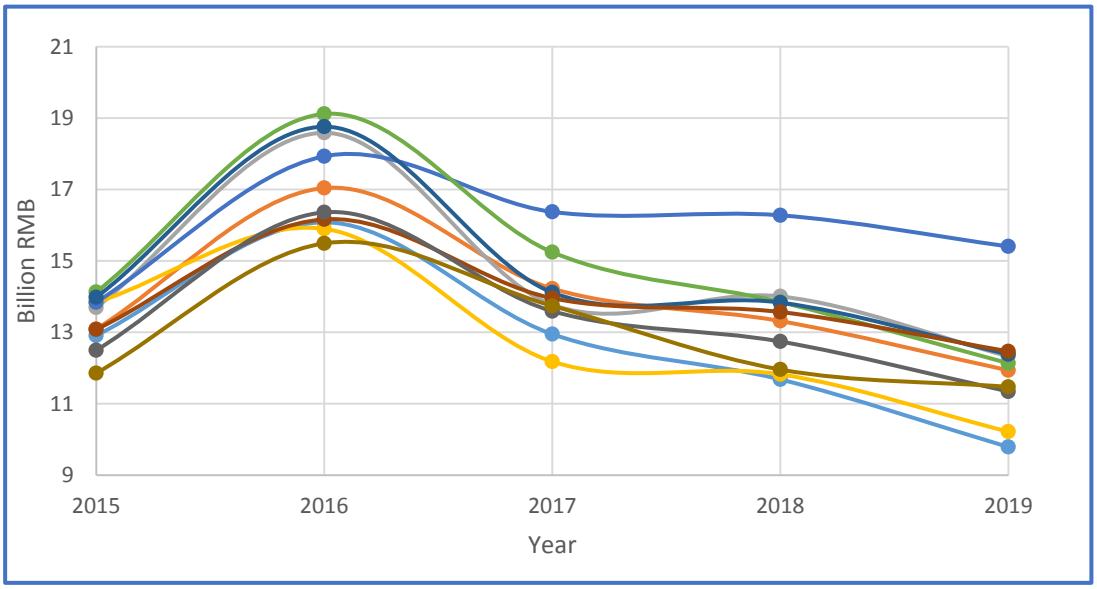
Depending on formula (2.43), we can get value of first phrase, 2015 is the first of our calculation, so PV of 2015 is equal to FCFE divided 1 plus E(R1), 2016 is our second year, PV of 2016 is equal to FCFE in 2016 divided the power of 1 plus E(R1), the similar process as the other years, after we get all result in first phase, plus them, we get V1.Following it is in Table 4.26:

Table 4.26 First Phase valuation of first 10 scenarios (in billion RMB)

			PV			
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**V1**
Scenario 1	12.910	16.080	12.950	11.680	9.788	63.408
Scenario 2	13.091	17.041	14.223	13.316	11.935	69.606
Scenario 3	13.696	18.589	13.772	14.006	12.330	72.392
Scenario 4	13.835	15.900	12.180	11.824	10.218	63.956
Scenario 5	13.839	17.930	16.374	16.278	15.407	79.827
Scenario 6	14.130	19.117	15.244	13.848	12.134	74.473
Scenario 7	13.980	18.759	14.115	13.834	12.385	73.074
Scenario 8	13.080	16.163	13.955	13.569	12.467	69.234
Scenario 9	12.498	16.360	13.593	12.742	11.343	66.536
Scenario 10	11.855	15.492	13.741	11.957	11.472	64.517

For looking more visible, we provide a chart which including PV from 2015 to 2019 for these 10 scenarios in first phrase, following it is:

Chart 4.17 Present value of FCFE from 2015 to 2019 in first phrase for 10 scenarios



Next we need to calculate second phase according to formula (2.47) and (2.49), here we assume that growth rate equal to 0, after we get second stage vale of equity, V1 and V2 equal to total value of company, following are result in Table 4.27

Table 4.27 Total equity value of company (in billion RMB)

	V1	V2	Total value of equity
Scenario 1	63.408	58.920	122.328
Scenario 2	69.606	68.680	138.286
Scenario 3	72.392	73.126	145.518
Scenario 4	63.956	64.045	128.001
Scenario 5	79.827	88.139	167.966
Scenario 6	74.473	68.050	142.523
Scenario 7	73.074	73.350	146.424
Scenario 8	69.234	69.011	138.245
Scenario 9	66.536	72.255	138.791
Scenario 10	64.517	68.185	132.702

From now on we get equity of company, it has 10000 scenarios, next we make the distribution analysis. Following are items in Table 4.28:

Table 4.28 Items of distribution

Items	Value of Equity
Min	110.407
Max	196.658
Interval	20
Step	4.313

(money units for min and max are in billion RMB)

Before we make distribution analysis, we should know some key items, Min means the minimum number of value of equity, Max means maximum number of value of equity, we choose 20 as the interval. It means we divide 10000 scenarios into 20 parts. The step is different because the length of value is different. The step of value of equity is 4.313. following are result of frequency and probability for value of equity:

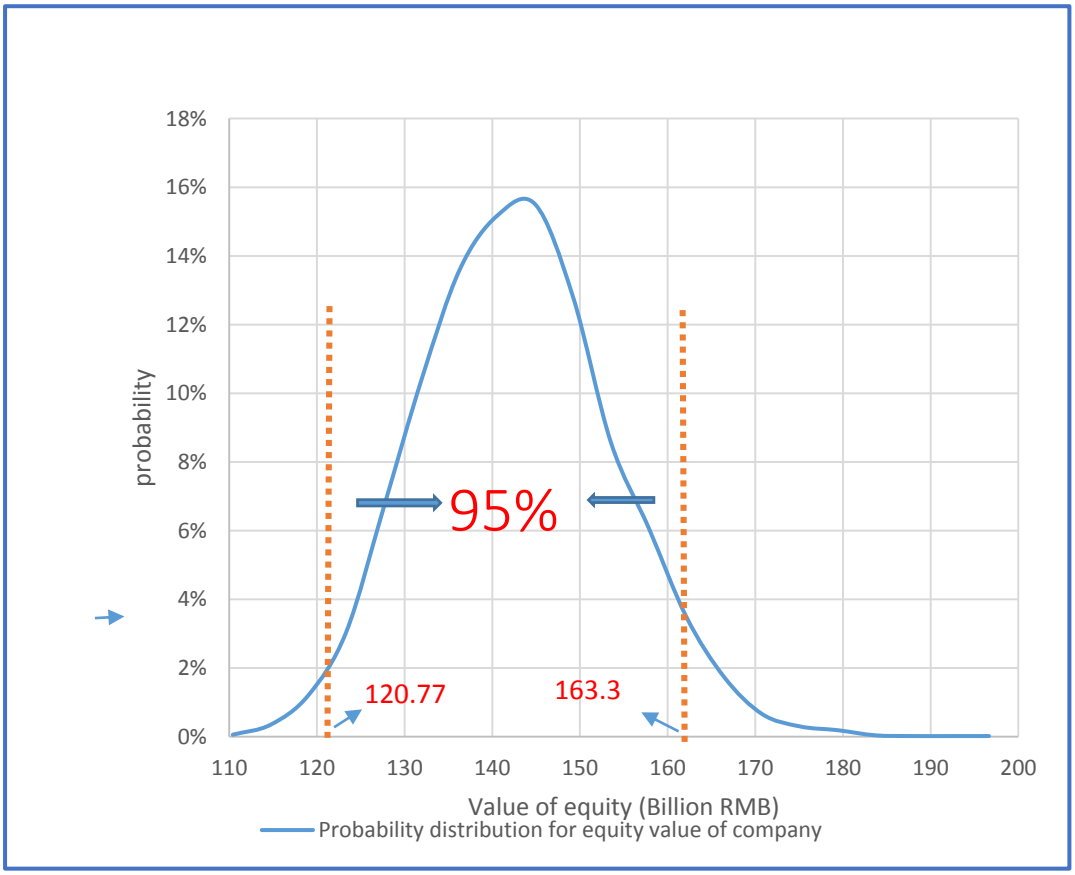
Table 4.29 Frequency and Probability of valuation

Value of equity	Frequency	Probability
110.407	6	0.06%
114.720	35	0.35%
119.032	121	1.21%
123.345	305	3.05%
127.658	671	6.71%
131.970	1043	10.43%
136.283	1360	13.60%
140.595	1518	15.18%
144.908	1550	15.50%
149.220	1280	12.80%
153.533	857	8.57%
157.845	608	6.08%
162.158	348	3.48%
166.470	173	1.73%
170.783	66	0.66%
175.096	30	0.30%
179.408	19	0.19%
183.721	4	0.04%
188.033	2	0.02%
192.346	2	0.02%
196.658	2	0.02%
SUM	10000	1
percentile	2.50%	120.772
percentile	97.50%	163.301

(money units for value of equity in billion RMB)

For looking more obvious we can make Chart 4.18 for probability distribution for value of equity following it is:

Chart 4.18 Probability for equity value of company



The highest probability equity value of company is between 140.595 to 144.908, with probability more than 15%. The lowest probability value of equity is between 188.033 to 196.658, with probability lower than 0.02%. we get percentile 2.5% and percentile 97.5%, which means with 95% probability company's equity value could between 120.77 to 163.33, with 5% probability company's equity value could be less than 120.77 or bigger than 163.3. After probability distribution, we make data analysis when growth rate equal to 0, following it is in Table 4.30:

Table 4.30 Data analysis for equity value of company

g	Mean	Variance	standard derivation	Percentile 2.5%	Percentile 97.5%
0%	140.741	119.790	10.945	120.77	163.3

We make calculation under assumption growth rate equal to 0, so g equal to 0. we choose 95% as distribution confidence interval, so with 95% company's equity value could between 120.77 to 163.3. Mean means average of 10000 scenarios equity value. both variance and standard derivation describe fluctuation of equity value The standard deviation is 10.945 which means the fluctuation of valuation is 10.945.

4.8 Sensitivity analysis

In this part, we will performence sensitivity analysis ,here we analysis how the growth rate g influence the equity value. When we calculate V2, we assume that growth rate is equal to 0, so we use formula (2.47) and (2.50), after we consider about growth rate, we will use formula (2.48) and (2.50). when the growth rate change, how much effect it has on equity value of company, we assume that growth rate would be -3%, -2%, -1% ,0% ,1% ,2% ,3% , calculate company's equity value under every assumption growth rate, to see how much effect it has on equity value of company. Six different growth rate we will get six types of valuation, every type with 10000 scenarios, in order to express it more clearly, we will make a probability distribution for them, firstly we need to know some key items for distribution, following it is in Table 4.31:

Table 4.31 Items for probability distribution

g	-3	-2	-1	1	2	3
Min	86.271	87.976	89.849	94.209	96.768	99.641
Max	182.387	186.697	191.432	202.456	208.924	216.187
Internal	20	20	20	20	20	20
Step	4.806	4.936	5.079	5.412	5.608	5.827

(money units for min and max are in billion RMB)

Min means minimum number of total equity value under different growth rate, Max means maximum number of total equity value under different growth rate, we choose 20 as internal, step equal to max number minus minimum number divided by 20 as we describe in formula (4.1), using the same process in excel as we introduce in probability distribution for EAT, we can get frequency and probability for value of equity under different growth rate. following it is in Table 4.32 and 4.33:

Table 4.32 Probability and Frequency distribution of equity value

g=-3%			g=-2%			g=-1%		
Interval	**F**	**P**	**Interval**	**F**	**P**	**Interval**	**F**	**P**
86.271	1	0.01%	87.976	1	0.01%	89.849	1	0.01%
91.077	0	0.00%	92.912	0	0.00%	94.928	0	0.00%
95.883	0	0.00%	97.848	0	0.00%	100.007	0	0.00%
100.688	2	0.02%	102.784	2	0.02%	105.086	2	0.02%
105.494	15	0.15%	107.720	16	0.16%	110.166	17	0.17%
110.300	110	1.10%	112.656	109	1.09%	115.245	106	1.06%
115.106	333	3.33%	117.592	331	3.31%	120.324	333	3.33%
119.912	867	8.67%	122.528	877	8.77%	125.403	884	8.84%
124.717	1327	13.27%	127.464	1331	13.31%	130.482	1334	13.34%
129.523	1811	18.11%	132.400	1817	18.17%	135.561	1823	18.23%
134.329	1871	18.71%	137.336	1873	18.73%	140.641	1874	18.74%
139.135	1587	15.87%	142.273	1582	15.82%	145.720	1584	15.84%
143.940	995	9.95%	147.209	988	9.88%	150.799	977	9.77%
148.746	620	6.20%	152.145	619	6.19%	155.878	618	6.18%
153.552	298	2.98%	157.081	290	2.90%	160.957	285	2.85%
158.358	98	0.98%	162.017	100	1.00%	166.036	98	0.98%
163.164	40	0.40%	166.953	39	0.39%	171.115	40	0.40%
167.969	17	0.17%	171.889	18	0.18%	176.195	16	0.16%
172.775	4	0.04%	176.825	3	0.03%	181.274	4	0.04%
177.581	2	0.02%	181.761	2	0.02%	186.353	2	0.02%
182.387	2	0.02%	186.697	2	0.02%	191.432	2	0.02%
Sum	**10000**	**1**	**Sum**	**10000**	**1**	**Sum**	**10000**	**1**

(money units for interval in billion RMB)

Table 4.33 Probability and Frequency distribution of equity value

g=1%			g=2%			g=3%		
Interval	**F**	**P**	**Interval**	**F**	**P**	**Interval**	**F**	**P**
94.209	1	0.01%	96.768	1	0.01%	99.641	1	0.01%
99.622	0	0.00%	102.376	0	0.00%	105.468	0	0.00%
105.034	0	0.00%	107.983	0	0.00%	111.295	0	0.00%
110.446	2	0.02%	113.591	2	0.02%	117.122	2	0.02%
115.859	17	0.17%	119.199	17	0.17%	122.950	18	0.18%
121.271	104	1.04%	124.807	106	1.06%	128.777	107	1.07%
126.683	344	3.44%	130.415	347	3.47%	134.604	354	3.54%
132.096	884	8.84%	136.023	887	8.87%	140.432	893	8.93%
137.508	1355	13.55%	141.630	1363	13.63%	146.259	1360	13.60%
142.920	1824	18.24%	147.238	1840	18.40%	152.086	1856	18.56%
148.333	1900	19.00%	152.846	1890	18.90%	157.914	1882	18.82%
153.745	1556	15.56%	158.454	1544	15.44%	163.741	1538	15.38%
159.157	968	9.68%	164.062	970	9.70%	169.568	967	9.67%
164.570	600	6.00%	169.670	592	5.92%	175.396	585	5.85%
169.982	288	2.88%	175.277	284	2.84%	181.223	285	2.85%
175.394	93	0.93%	180.885	96	0.96%	187.050	90	0.90%
180.807	40	0.40%	186.493	36	0.36%	192.878	36	0.36%
186.219	16	0.16%	192.101	17	0.17%	198.705	18	0.18%
191.631	4	0.04%	197.709	4	0.04%	204.532	4	0.04%
197.044	2	0.02%	203.317	2	0.02%	210.360	2	0.02%
202.456	2	0.02%	208.924	2	0.02%	216.187	2	0.02%
Sum	**10000**	**1**	**Sum**	**10000**	**1**	**Sum**	**10000**	**1**

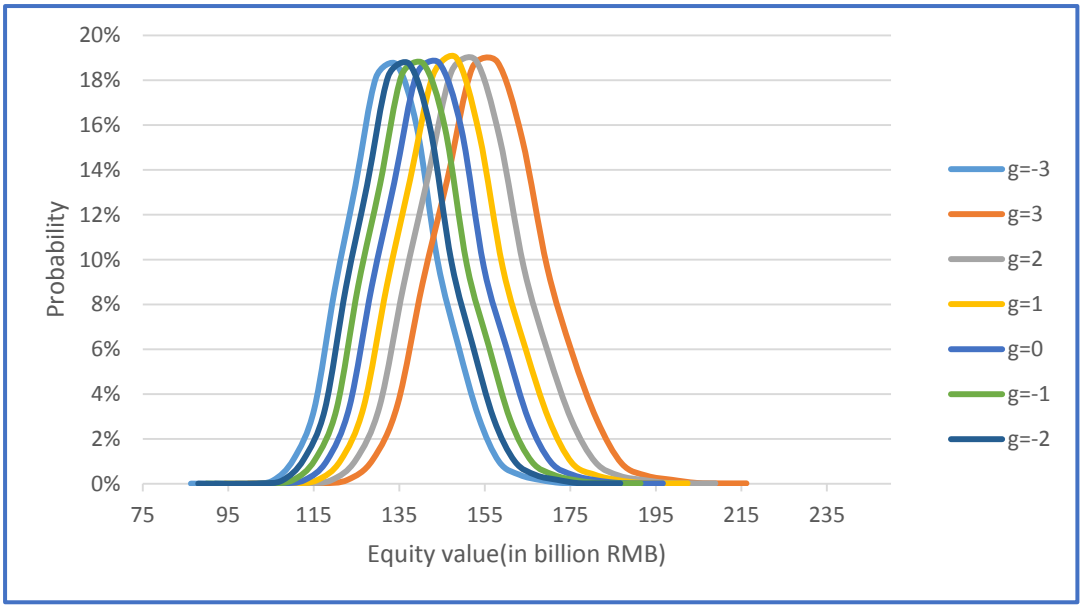
(money units for interval in billion RMB)

Interval is value of equity for company under different growth rate from min to max, with the growth rate increase, the min and max of company's equity increase as well. Frequency means how many scenarios of equity value in that interval, the higher frequency is, the more scenarios equity value of company could be in this interval, the right side is their probability. It is calculated by each interval frequency divides the 1000 scenarios. The higher probability is, the more possible that equity value of company could be in this internal. When with -3% growth rate, the highest probability equity value of company is in interval 129.523 to 134.329. When with -2% growth rate, the highest probability equity value of company is in interval 132.4 to 137.336. When with -1% growth rate, the highest probability equity value of company is in interval 135.561 to 140.641. When with 1% growth rate, the highest probability equity value of

company is in interval 142.920 to 148.333. When with 2% growth rate, the highest probability equity value of company is in interval 147.238 to 152.846, When with 3% growth rate, the highest probability equity value of company is in interval 152.086 to 157.914.

And then for looking more visual and comparing each year we can make those data together in Chart 4.29.

Chart 4.29 Equity value of company under different growth rate



From chart 4.29 we can see that the highest probability under difference growth rate is very similar, the lowest probability under difference growth rate is similar as well, the difference for each growth rate is the highest probability distribute in different interval. The highest probability is 19% under growth rate is 1%, the lowest probability is 0%, which means company's equity value couldn't not be in this interval or with very small chance in this interval. Next step we will use 95% interval to analysis these equity value of company under different growth rate, following it is in Table 4.34:

Table 4.34 Data analysis (billion RMB)

g	Mean	variance	standard deviation	Percentile 2.5%	Percentile 97.5%
3%	153.776	147.684	12.153	131.688	178.942
2%	148.928	136.947	11.702	127.644	173.139
1%	144.611	127.746	11.302	124.024	167.948
-1%	137.253	112.852	10.623	117.845	159.225
-2%	134.092	106.759	10.332	115.241	155.438
-3%	131.215	101.372	10.068	112.806	151.919

From Table 4.34 we can see that we do data analysis for equity value of company under different growth rate. Mean means average of 10000 scenarios equity value. both variance and standard derivation describe fluctuation of equity value. As we choose 95% as distribution confidence interval, so on the left side the percentile is 2.5% and on the right side the percentile is 97.5%. When growth rate is 3%, with 95% probability that equity value of our company could in between 131.688 to 178.942. The standard deviation is 12.153 which means the fluctuation of valuation is 12.153. When growth rate is 2%, with 95% probability that equity value of our company could in between 127.644 to 173.139. The standard deviation is 11.702 which means the fluctuation of valuation is 11.702. When growth rate is 1%, with 95% probability that equity value of our company could in between 124.024 to 167.948. The standard deviation is 11.302 which means the fluctuation of valuation is 11.302. When growth rate is -1%, with 95% probability that equity value of our company could in between 117.845 to 159.225. The standard deviation is 10.623 which means the fluctuation of valuation is 10.623. When growth rate is -2%, with 95% probability that equity value of our company could in between 115.241 to 155.438. The standard deviation is 10.332 which means the fluctuation of valuation is 10.332. When growth rate is -3%, with 95% probability that equity value of our company could in between 112.806 to 151.919. The standard deviation is 10.068 which means the fluctuation of valuation is 10.068.

From the Chart 4.29 we can find the growth rate has a positive correlation with total equity value. It means the higher growth rate will lead to a higher equity value. The growth rate has a positive correlation with standard deviation. It means the growth rate is increasing will lead to the standard deviation increasing as well.

5 Conclusion

Huaneng company is one of biggest power company in China, which play a very important for whole economic in China. The main objective of our thesis is to estimate equity value of Huaneng company in power sector under risk terms.

First, we did financial analysis for component ratio of ROE to see how these ratio change during 2005 to 2014. After that by using gradual changes method, we found out that the change of net profit margin has biggest influence on ROE, next we focus on net profit margin. Depending on arrangement of Vasicek model, we make a prediction for net profit margin with 10000 scenarios, most of net profit margin as we prediction is between 10% to 12%.

Depending on methodology we describe in chapter 2, we did prediction for Revenue, Depreciation, Investment outlays and net payment. After that by using CAPM model, we get cost of equity for Huaneng company. Depending on 2-stage DCF method, we get 10000 scenarios value of equity for Huaneng company with growth rate is zero, and we made probability distribution for 10000 scenarios, we found that, when growth rate equal to 0, with 95% probability that equity value of Huaneng company is between 120.77 billion RMB to 163.3 billion RMB. Then, we made sensitivity with growth rate increase and growth decrease, to find out how company's equity could change, we found, with growth rate increase, company's equity value increase as well, with growth rate decrease, company's equity value decreasing as well. Finally, we do probability distribution for every growth rate to show how company's equity value change.

Finally, we get equity value of Huaneng company by using DCF method, but during calculated process, we found out some imperfect place for further study on this topic. For instance, if the FCFE for the company is very stable or with obvious trend, it is easy and reasonable we can prediction future FCFE, but is future FCFE is not stable and with no trend, even with negative FCFE, DCF method will not reasonable.

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List of Abbreviations

DCF	Discount cash flow
FCF	Free cash flow
FCFF	Free cash flow for the firm
FCFE	Free cash flow for equity
FCFD	Free cash flow for debt
IPO	Initial public offering
EVA	Ecomic value added
ROE	Return on equity
WMA	Weight moving average
EAT	Earning after tax
DEP	Depreciation
NWC	Net working capital
GDP	Gross Domestic Product
CAPM	Capital assets pricing model
APM	Arbitrage pricing model
WACC	Weight moving average cost of capital
NPV	Net present value
D/E	Debt/ Equity
RMB	Ren Min Bi

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Ostrava dated 20. 4. 2016

FOR LOAN

Student´s name and surname

List of Annexes

Annex 1 balance sheet of Huaneng company from 2005 to 2014

Financial Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Monetary Funds	2.8516	3.4111	7.5328	5.7659	5.4520	9.5479	8.6700	10.6245	9.4334	12.6082
Held-for-trading Financial Assets	0.0000						0.0962	0.0938		
Notes Receivable	1.1175	0.7958	1.6749	0.6663	0.3516	0.6365	0.5634	0.3576	0.7553	0.8064
Accounts Receivable	4.9049	6.1817	6.2014	7.1282	9.6913	10.2726	14.8145	14.9424	14.8068	14.0756
Advances to Suppliers	0.2686	0.3943	0.5372	0.6591	1.0242	1.2285	1.0322	1.0109	0.4350	0.7415
Other Receivables	0.5978	0.2060	0.2818	0.4240	1.1834	1.6029	1.2718	0.9398	0.7936	0.9923
Amounts Due From Related Companies										
Interest Receivable	0.0031	0.0016	0.0023	0.0020	0.0007	0.0007	0.0000	0.0001	0.0001	0.0003
Dividend Receivable		0.0000					0.1201	0.0500	0.1500	0.1890
Inventories	2.3114	2.1215	2.3193	5.1698	4.0840	5.1904	7.5256	7.0224	6.4690	6.7023
Among: Consumptive Biological Assets										
Non-Current Assets Maturing Within One Year				0.0102	0.0195	0.1013	0.0221	0.0137	0.0138	0.1791
Other Current Assets	0.0083	0.0142	0.0015	0.1927	0.1880	0.2136	0.2882	0.0899	0.6667	0.2975
Total Current Assets	12.0632	13.1261	18.5511	20.0182	21.9948	28.7946	34.4040	35.1451	33.5237	36.5921
Available-for-Sale Financial Asset			3.3466	1.2620	2.2940	1.9497	1.6545	1.7694	1.6278	4.3834
Held-to-maturity Investments	0.0001									
Long-Term Account Receivable						0.7096	0.7417	0.8239	0.7262	0.5308
Long-term Equity Investment	6.4790	6.8404	8.5111	8.7450	9.5505	11.9826	14.0076	15.6533	17.9519	17.3816
Investment Properties										
Fixed Assetes	56.1704	75.8630	76.0625	91.2916	108.7687	123.6534	154.8080	159.3631	160.9261	169.7443
Under-construction Projects	13.9070	8.7034	8.8035	13.6408	23.6370	26.2431	22.1653	17.9474	18.8775	17.0145
Construction Materials	6.2892	3.7381	4.0797	11.4921	8.7649	6.0150	1.7661	0.7089	2.6783	2.6063
Disposal of Fixed Assets						0.0870	0.1528	0.0932	0.0586	0.0628
Capitalized Biological Assets										
Oil and Gas Assets										
Intangible Assets	-0.1778	0.0433	2.3217	6.8009	7.0859	7.5072	10.2072	10.3620	10.3501	10.6873
R&D expenses										
Goodwill			0.1294	10.6730	10.9122	11.9555	13.2048	13.8399	12.1810	11.1485
Long-Term Deferred and Prepaid Expenses	0.0614	0.0446	0.0762	0.1818	0.1641	0.1543	0.1817	0.1581	0.1502	0.1645
Deferred Income Tax Assets			0.2577	0.3845	0.5477	0.8672	0.7106	0.6728	0.7626	0.9989
Other Non-Current Assets	0.1555	0.1326		0.0978	0.2774	4.0336	0.3612	0.3247	0.4608	0.8501
Sub-Total of Non-Current Assets	82.8848	95.3653	103.5883	144.5695	172.0023	195.1582	219.9613	221.7168	226.7511	235.5729
Total Assets	94.9479	108.4915	122.1394	164.5877	193.9971	223.9527	254.3654	256.8619	260.2749	272.1649

Billion RMB

Annex 1 balance sheet of Huaneng company from 2005 to 2014

Short-Term Loans	6.5809	7.8237	11.6704	28.7455	24.7298	44.0472	43.9792	27.4421	37.9370	43.5290
Trading Financial liabilities							0.0355	0.0886		
Notes Payable	0.0872	0.7515	0.3325	0.0121	0.0715	0.0754	0.0134	0.0549	0.1034	1.1180
Accounts Payable	1.1519	1.3244	2.0172	2.9979	4.3150	5.3398	9.1091	7.2994	12.1745	10.5672
Accounts Received In Advance					0.1027	0.1377	0.1308	0.1613	0.1478	0.3528
Employee Compensation Payable	0.2519	0.4416	0.2134	0.2122	0.2905	0.2711	0.2303	0.2180	0.1888	0.1713
Taxes Payable	1.1736	1.2487	0.9553	0.4205	-1.5441	-2.0173	-0.9948	-0.2072	0.4098	-0.3972
Interest Payable	0.1976	0.1956	0.1811	0.4243	0.4902	0.5770	0.6874	0.8978	1.0474	1.0562
Dividend Payable	0.1383		0.0122	0.0567	0.0207	0.0797	0.1676	0.0708	0.1663	0.4317
Other payables	4.1293	4.9415	5.7024	6.3544	8.3746	12.2371	14.6624	10.2463	10.6774	13.2747
Due to Related Companies										
Non-Current Liabilities Due Within One Year	3.1660	3.3320	4.2195	6.5454	9.2502	13.7826	15.1364	9.0567	18.4876	12.7428
Other Current Liabilities	5.0421	5.2468	5.2280	5.8827	10.4555	5.5257	10.6074	35.9539	15.8426	19.4477
Sub-Total of Current Liabilities	21.9189	25.3058	30.5321	51.6517	56.5568	80.0558	93.7649	91.2827	97.1826	102.2943
Long-term Loans	28.8623	35.0986	33.4386	59.0272	71.2668	65.1849	79.8449	72.5648	60.5137	57.6385
Bonds Payable			5.8856	9.8347	13.8001	13.8312	17.8549	22.8847	23.7266	22.7255
Long-Term Accounts Payable					0.0239	0.0832	0.1436	0.2559	0.2088	1.3546
Special Payable	0.0865	0.2035	0.2772			0.0027	0.0412	0.0509	0.0515	0.0450
Estimatied Liabilities										
Deferred Income Tax Liabilities			0.7703	1.0910	1.3865	1.6057	1.7369	1.7762	1.7889	1.5950
Other Non-Current Liabilities	0.0641	0.0378	0.4697	1.4102	2.2462	2.3300	2.8192	3.1285	2.7582	0.6495
Sub-Total of Non-Current Liabilities	29.0129	35.3399	40.8415	71.3631	88.7235	83.0377	102.4407	100.6610	89.0476	86.4508
Total Liabilities	50.9317	60.6457	71.3736	123.0149	145.2802	163.0935	196.2055	191.9436	186.2302	188.7450
Paid-In Capital(Or Share Stock)	12.0554	12.0554	12.0554	12.0554	12.0554	14.0554	14.0554	14.0554	14.0554	14.4204
Capital Surplus	8.7654	8.9303	10.7005	8.6694	9.3491	17.7462	17.1319	17.0345	16.6625	18.7632
Surplus Reserve	4.9457	5.5007	6.1423	6.1423	6.1423	7.0049	7.0601	7.1317	7.1317	7.2426
LESS:Treasury Stock										
Undistributed Profits	13.3151	15.2966	17.2214	9.9139	13.8307	13.9786	12.3718	17.3576	24.6696	29.7528
Minority Stockholder's Interest	4.9346	6.0628	4.6461	5.3262	7.7014	7.9679	8.0846	9.3375	12.2968	14.2217
Foreign Currency Capital				-0.5344	-0.3621	0.0934	-0.5710	-0.0359	-0.8172	
Abnormal Management Project Income Adjusted										
Total Owners' Equity Attributable to Parent(Stockholder's Interest)	39.0816	41.7830	46.1197	36.2466	41.0155	52.8913	50.0753	55.5808	61.7478	69.1982
Owner's Equity（Stockholder's Equity）	44.0162	47.8458	50.7657	41.5728	48.7169	60.8592	58.1599	64.9182	74.0446	83.4199
Total Liabilities and Owner's Equity（Stockholder's Equity）	94.9479	108.4915	122.1394	164.5877	193.9971	223.9527	254.3654	256.8619	260.2749	272.1649

Billion RMB

Annex 2 Income statements of Huaneng company from 2005 to 2014

Financial Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1、Operating Income	40.2478	44.3128	50.4346	67.8251	79.7423	104.3077	133.4208	133.9667	133.8329	125.4069
LESS: Operating Cost	31.3741	33.7769	40.9431	66.8763	66.9612	92.8185	121.8168	112.1365	102.8650	94.0105
Operating Tax and Extra	0.1135	0.1481	0.1511	0.1064	0.1656	0.1476	0.4840	0.6720	1.0439	0.9325
Selling Expenses				0.0025	0.0034	0.0040	0.0091	0.0060	0.0091	0.0044
Management Fees	0.9487	1.1406	1.5240	1.8549	2.3603	2.7245	2.9162	3.0874	3.4334	3.5883
Exporating Expenses										
Financial Expenses	1.2854	1.7069	1.9391	3.6244	4.4354	5.1056	7.4935	8.8885	7.5226	7.6641
Assets Impairment Loss			-0.0065	0.0927	0.6588	0.0293	0.3651	0.8716	1.4562	2.1216
ADD:Income from Changes In Fair Value			-0.1002	-0.0547	-0.0336	0.0119	-0.0007	-0.0012	-0.0057	0.0425
Investment Income	0.2287	0.2677	1.3411	0.1848	0.8095	0.6321	0.8039	0.8173	0.8510	1.4239
AMONG:Joint Enterprises and Joint Ventures to Investment Returns			0.5862		0.7528	0.5720	0.6605	0.6302	0.6261	1.3430
Influence Operating Profit of Other Subjects	0.0630	0.0488								
2、Operating Profit	6.8178	7.8568	7.1247	-4.6019	5.9334	4.1222	1.1393	9.1208	18.3479	18.5520
ADD: Subsidies Income	0.0278	0.0063								
Non-Operating Income	0.0425	0.0199	0.3032	0.2946	0.2789	0.5650	1.3778	0.6940	0.4490	0.9846
LESS:Non-Operating Revenue	0.2090	0.1330	0.0380	0.1258	0.1625	0.0938	0.1689	0.3875	1.1477	0.6618
AMONG:Non-Current Assets Disposal Net Loss			0.0148	0.0704	0.1056	0.0505	0.0470	0.2843	0.9159	0.4458
ADD: Influence of Total Profit of Other Subjects										
3、Total Profit	6.6790	7.7500	7.3899	-4.4330	6.0498	4.5934	2.3481	9.4273	17.6493	18.8748
LESS:Income Tax	1.1054	1.3046	0.9723	-0.2198	0.6567	0.9131	0.9839	2.5748	4.5450	5.5106
ADD:Influence Net Profit of Other Subjects										
4、Net Profit	5.5736	6.4454	6.4176	-4.2132	5.3931	3.6803	1.3643	6.8525	13.1043	13.3642
Owners' Net Profit Attributable to Parent	4.7626	5.5504	5.9971	-3.7012	5.0810	3.5443	1.2682	5.8687	10.5201	10.5458
Minority Interest Income	0.8110	0.8950	0.4205	-0.5120	0.3121	0.1360	0.0960	0.9838	2.5842	2.8185

Billion RMB

Annex 3 Cash flow statements from 2005 to 2014

Reporting Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 .Cash flow from operating activities										
Cash Received From Sales of Goods and Rendering of Services	46.1460	51.3644	57.3595	76.0707	87.4709	117.8939	145.1611	150.8095	150.5864	141.1021
Tax Rebates Received	0.0492				0.0337	0.0298	0.0957	0.1917	0.2522	0.1012
Other Cash Received Concerning Operating Activities	0.1586	0.1064	0.1944	0.4379	0.2346	0.6920	1.7596	1.3325	0.9650	0.8686
Sub-total of Cash Inflows from Operating Activities	46.3538	51.4708	57.5539	76.5086	87.7393	118.6156	147.0164	152.3337	151.8036	142.0719
Cash Paid For Goods Purchased and Services Received	25.4379	27.3386	34.1386	62.2270	60.8576	90.2895	115.1066	110.0349	89.7556	86.3200
Cash Paid to and For Employees	2.4606	2.7889	3.0093	3.3129	3.7708	4.1969	4.8687	5.2972	5.7310	6.2082
Cash Paid For Taxes and Surcharges	5.4758	6.2012	6.5526	4.9416	6.1847	5.1379	5.0525	8.5651	14.3524	14.6049
Other Paid Cash Relevant To Operating Activities	2.4493	1.3579	1.6320	0.8412	0.9368	0.9246	1.0394	1.5085	1.7252	1.6188
Sub-Total of Cash Outflow From Operating Activities	35.8236	37.6865	45.3325	71.3227	71.7499	100.5489	126.0672	125.4056	111.5641	108.7519
Net Cash Flow From Operating Activities	10.5301	13.7843	12.2214	5.1859	15.9894	18.0667	20.9492	26.9281	40.2394	33.3201
2. Cash flow from investing activities	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cash Received From Sales of Investments	0.0626	0.0028	0.6039				0.1043	0.1000	0.1028	0.3847
Investment Income Received	0.4296	0.4826	0.5189	0.3819	0.5402	0.3152	0.4477	0.7288	0.4082	0.5653
Net Cash From Disposal of Fixed Assets, Intangible Assets and Other Long-term Assets	0.0589	0.0322	0.2701	0.0253	0.0393	0.1058	0.0856	0.9495	0.1665	0.0707
Net Cash Received From Disposal of Subsidiaries and Other Business Units									0.0062	0.5038
Other Cash Received Relating to Investing Activities	0.0210	0.0534		0.2667	0.0044	0.0381	0.0681	0.1434	0.2458	0.0710
Sub-Total of Cash inflow From Investing Activities	0.5721	0.5710	1.3930	0.6739	0.5839	0.4592	0.7056	1.9217	0.9295	1.5955
Cash Paid For Purchase and Construction of Fixed Assets, Intangible Assets and Other Long-term Assets	13.9842	16.2860	15.4423	27.9856	22.9301	20.7317	16.7887	15.6076	17.7299	20.3799
Cash Paid For Acquisition of Investments	0.2880	0.1749	2.9894	0.4970	0.9108	0.8810	1.8098	1.4476	2.2271	0.2669
Net Cash Paid For Acquisition of Subsidiaries and Other Business Units			0.3222	20.1485	2.3541	5.8270	3.7720	0.1490		0.0180
Other Cash Paid Relating to Investing Activities	1.6736							0.0270	0.0267	0.0169
Sub-Total of Cash Outflows From Investing Activities	15.9458	16.4609	18.7539	48.6310	26.1950	27.4397	22.3705	17.2313	19.9837	20.6816
Net Cash Flows From Investing Activities	-15.3737	-15.8899	-17.3609	-47.9571	-25.6112	-26.9805	-21.6648	-15.3096	-19.0543	-19.0861

Billion RMB

Annex 3 Cash flow statements from 2005 to 2014

3、Cash Flows From Financing Activities	5.2022	2.6689	9.2274	41.2553	8.7637	13.0633	0.0696	-9.8169	-22.2401	-11.2789
Cash Received From Capital Contributions	0.5857	0.5887	11.0485	1.1626	0.2605	10.5637	0.2192	0.6653	0.8682	3.0607
Borrowings Received	21.9546	24.4817	32.8547	94.3529	74.8411	72.4058	86.3952	67.7200	46.4052	71.1503
Amounts Of Other Received Cash Relevant to Financing Activities	4.9449	5.1759	0.2299	9.1493	14.3323	10.2517	0.2294	0.3726	0.2745	1.7433
Sub-Total of Cash Inflows From Financing Activities	27.4852	30.2463	44.1331	104.6648	89.4339	93.2212	101.7885	108.6729	78.9829	97.9133
Repayment Of Borrowings	16.9550	21.5608	28.2647	54.7382	73.3882	71.2935	90.4944	108.3163	88.7584	94.1192
Cash Paid For Dividend and Profit Distribution Or Interest Payment	5.3054	6.0166	6.6257	8.6037	7.2454	8.7744	11.0722	10.1053	11.7819	14.9126
Other Cash Payments Relating Financing Activities	0.0225		0.0154	0.0676	0.0366	0.0900	0.1523	0.0682	0.6827	0.1605
other cash payments relating to financing activites	22.2829	27.5774	34.9057	63.4095	80.6701	80.1579	101.7188	118.4898	101.2230	109.1922
Sub-Total of Cash Ouflows From Financiing Activities	5.2022	2.6689	9.2274	41.2553	8.7637	13.0633	0.0696	-9.8169	-22.2401	-11.2789
4、Foreign Exchange Rate Fluctuation Consequences On Cash	-0.0065	-0.0038	-0.0043	-0.2298	0.0557	0.0499	-0.2276	0.1510	-0.1088	-0.0584
5. Net incresaing in cash and cash equivalents	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
The Initial Cash and Cash Equivalents Balance	2.2955	2.6477	3.2286	7.3123	6.0293	5.2270	9.4264	8.5528	10.5054	9.3417
The Final Cash and Cash Equivalents Balance	2.6477	3.2072	7.3123	5.5666	5.2270	9.4264	8.5528	10.5054	9.3417	12.2384
Note：1、Note:Adjusting Net Profit to Determine Cash Flows From Operating Activities										
Net profit	5.5736	6.4454	6.4176	-4.2132	5.3931	3.6803	1.3643	6.8525	13.1043	13.3642
ADD:Provision For Assets Impairment	0.0519	-0.0262	-0.0065	0.0927	0.6588	0.0293	0.3651	0.8716	1.4562	2.1216
Depreciations Of Fixed Assets, Oil & Gas Gssets, and Capitalized Biological Assets	5.8314	6.4041	7.1069	7.5321	9.1014	10.1752	11.7152	10.9129	11.2686	11.7248

Billion RMB